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MASTER CAR BUILDERS' ASSOCIATION.

THIRTY-SIXTH ANNUAL CONVENTION.

Saratoga, N. Y., June, 1902.

The convention was called to order at 10 A. M., June 18, at Saratoga Springs, by President J. J. Hennessey, the attendance being unusually large. After the opening prayer by the Rev. H. M. Gesner, the Hon. Adelbert P. Knapp, president of the village, welcomed the association for the ninth convention at Saratoga. Mr. A. M. Waitt responded in his usual happy manner. The address of President Hennessey was an admirable statement of the purposes and objects of the association, the interchange rules being given the highest place in his estimate of its work. But 19 disputes had been submitted to the Arbitration Committee during the year, this being an excellent exhibit of the smooth operation of the rules. Construction, repairs and especially uniformity in construction constituted the most important field for the immediate future. Progress should be the rule. A closer adherence to the established standards was urged upon the members. Attention was directed to the necessity for considering the increasing rigor of service in the construction of cars throughout. The increase of capacity had been accompanied by greater demands for strength throughout. The address was thoughtful and suggestive. It did not include a review of past history or prophesy for the future, but constituted a concise presentation of the work in hand. It was an admirable, practical appeal for good, effective work, and was well received.

The report of the secretary showed the total membership at present to be as follows: Active, 275; representative, 190; associate, 8, and life, 18; a total of 491. The number of cars represented had increased to 1,630,016, an increase of 124,394 during the year. The funds on hand, in the treasury, amounted to $9,165.85, all bills being paid. The dues were reduced from $4 to $3 per vote per year, because of the large amount of money in the treasury.

Under the head of new business proposed changes in the constitution were considered. These related to the admission of honorary members, the names of candidates to come before the Executive Committee. A suggestion of a change in the constitution was offered, to extend the eligibility of active membership to mechanical engineers. This will be acted upon next year. A committee was appointed to consider the suggestions made by the president in his address.

Report of Committee on Standards.

But two changes in standards were proposed. The first was to strengthen the wedge-stop lugs on the outer end of the box for 5 x 9-in. journals, and the second provided for stenciling letters "A" and "B" on the ends of cars to indicate the end which carries the brake staff, for convenience of inspectors.

A number of changes in recommended practice were brought up in the report, all of which were adopted.

Topical Discussions.

"Advisability of Using Metal Center Sills in Wooden Car Construction."—Opened by R. P. C. Sanderson.

The speaker considered it a mistake to use a combination of steel and wood in underframes. Deflection, as well as carrying capacity, must be considered. Steel sills will deflect under their share of the load, and wooden sills, even if cambered, will give way, while the steel sills must take more than their share of the load, leading to breakage of the steel. He preferred entire steel underframes. The steel bolster was not objectionable, as it is a whole unit by itself, but steel and iron mixed brought up the question of uniform deflection, which could not exist with this construction. Mr. Streicher supported this view, citing the case of the sandwich bolster, in which shrinkage as well as deflection had given serious trouble. There was no question between steel and wood. Great strength was needed to meet the stresses of impact, and the implication was that entire underframes should be of steel. Mr. L. T. Canfield agreed with the previous speakers. A steel construction was needed to withstand buffing stresses. If steel is added to wooden underframes it should be placed below the wooden sills to take care of the draft gear stresses. Mr. Sanderson believed that a strong steel column should be provided to take the buffing shocks, which were far greater and more destructive than the pulling stresses. Enough metal should be provided to take advantage of the backbone of the car necessarily provided for vertical stresses to also carry the others. Mr. J. E. Simons was opposed to any combination of wood and steel. Moisture and decay were sure to occur at the contact surfaces. Bolting was sure to wear loose in the wood, subjecting the metal to undue stress. The time had come for all steel underframes. Mr. Hayward thought that the rapid extension of the use of steel cars meant that the time for combination of steel and wood was past.

"Meters for Stopping Leaks in Car Work Expenses."—Opened by G. W. Rhodes.

Municipal water service was used as an illustration of the wastes of water which had led to the use of meters to stop the unnecessary consumption. Railroad supplies were not metered. Headlights were left lighted unnecessarily because there was no check upon it. Pintsch gas was often left lighted when not needed. Better accounts would reveal these leaks. In freight car lubrication reductions of from 12 to 4 cents per 1,000 miles had been proved to be possible on a road of 4,000 miles, when accounts were kept, and a saving of $8,000 per year effected. The association was urged to watch these meters of consumption. This was evidently a suggestive subject to many members. Mr. Sanderson recommended the recording of statistics in the form of diagrams, which, by the slope of the line, would indicate the tendency of the figures. A busy man could see at a glance whether the line sloped upward or downward without

studying long tables of figures. The discussion was lively, and it brought out not only a marked interest in improvements, but a general testimony of efforts to meet commercial practice. This was revealed after a criticism by Professor Hibbard to the effect that railroad shops were generally far behind contract establishments in methods and facilities for shop work, railroad machinery being usually driven not above one-fourth of its capacity. Mr. T. H. Symington considered competent foremen as the best meters. Good mechanical meters cannot be had except for good prices. This applied equally well to the human meters.

Report of Committee on Triple Valve Tests.

Before taking up this subject Mr. W. E. Sharp directed attention to the effect of using triple valves in repairs which did not correspond to the leverages of the brake gear, and suggested that the rules should provide for the use of triples which would give the proper braking capacity. Triples should be replaced by those of the same make.

No triples had been submitted to the committee for test during the year.

In answer to a question, Mr. R. D. Smith stated that the Burlington & Missouri River had experimented with a triple valve (the Hibbard) which was constructed so as to provide different braking power for loaded and empty cars. Seven of these valves were tried and the results were sufficiently satisfactory to justify ordering 30 more. From the verbal report of the committee and the discussion it was evident that an adjustment of braking power between loaded and empty cars is needed, because of the great weight of large capacity cars and their loads. Mr. Herr, representing the Westinghouse Air Brake Company, was called on, and stated that that company was working on the problem of varying braking power and the improvement of methods of braking trains on long mountain grades, and would be ready with the devices when they are needed.

Laboratory Tests of Brake Shoes.

This report contained a recommendation of a series of road tests of brake shoes to check the results of the laboratory tests by actual service. The subject was referred to the Executive Committee for action.

Tests of M. C. B. Couplers.

This committee had been hampered in its work because of the use of the Altoona testing machine for the Draft Gear Committee.

In discussing necessary improvements in couplers the committee believed it wise to consider abandoning the link pin holes in the near future, as soon as satisfactory devices are secured for handling cars around short curves. As a result of tests made on the dimensions suggested last year, the committee realized that stronger lugs and greater strength through the pin hole were necessary. This involved modifications of contour which could be made very gradually.

To sum up, the committee believed that a head 11 ins. or 12 ins. deep, with a 9-in. or 10-in. face for a solid knuckle, the contour of which should be changed to admit the use of a 1¾-in. pin, would meet all the requirements of the heaviest service, but another year's experience with these heavier types is necessary before any definite recommendations can be given.

The construction of a testing machine for couplers and axles for the association at Purdue University was recommended, the university having offered facilities for its erection and maintenance.

This report reflected the opinion generally expressed throughout the convention, that it was necessary to provide in every possible way for the rough handling resulting from the increased weight of cars and trains. The Baltimore & Ohio, according to Mr. Stark, had for two years used knuckles without the link slot, and thus far had not found difficulties at all commensurable with the increased life of the knuckles. The committee had virtually recommended discarding the slot. Mr. Appleyard, of the committee, believed that the time had arrived to discontinue its use, as 29½ per cent. of the breakages were due to this slot and the pin hole. Mr. Waitt wished to see these omitted from the standard drawings, and made a motion with a view of leading to the purchase of knuckles without the slot and pin hole for trial during the year, the subject to be brought up as a change of standard next year if the experience is satisfactory. Carried. Mr. Waitt moved the acceptance of the offer of Purdue University with reference to testing machine. Carried.

At this point the convention was addressed by Chairman E. A. Moseley, of the Interstate Commerce Commission, his remarks being chiefly concerned with the pending bill with reference to safety appliances. If the location of hand holds and grab irons were transferred from recommended practice to the standard of the M. C. B. Association no legislation would be necessary. As a result of the safety appliance law the fatal accidents in coupling cars had been reduced one-quarter between the years 1893 and 1901, while the number of men employed was increased 12,000 during that time.

Cleaning Triple Valves.

In discussing this report Mr. F. M. Nellis, representing the Air Brakemen's Association, was called upon and offered valuable suggestions from the standpoint of the air brake inspectors. This led to the appointment of a committee to consider the suggestions in connection with the report for consideration at a later session. This was a rather unusual proceeding, but the plan was generally approved.

Interchange Rules.

This part of the proceedings was dispatched quickly and smoothly, considering the difficulties. The systematic method of securing suggestions from the railroad clubs, referring these to the Arbitration Committee and then to the association, is admirable and effective. There were no radical changes, except those made necessary by the recent adoption of the per diem system.

Maintenance of Steel Cars.

There was no printed report of this committee. Mr. Lewis stated the reason to be that experience with steel cars did not yet supply the information necessary for a report. There are about 70,000 cars in service, or one-tenth of 1 per cent. of the total car equipment in service, not enough to require provision of systematic methods for repairs. Prior to 1898 we had no steel cars to speak of. In 1897 the principal steel car manufacturer, the Schoen Company, turned out 501 cars. In 1898 they built 2,931; in 1899, 9,624; in 1900, 16,671, and in 1901, 24,590. The total number by this concern and its successor, the Pressed Steel Car Company, up to June 1 of this year, was 63,872 cars. No new tools or facilities or skilled labor had been found necessary. The time will come, however, when special facilities will be required. Mr. Stark (B. & O.) spoke of experience in repairs to 12,000 steel cars. Men worked in gangs of four and the work was specially favorable to piece work, which will soon be introduced. Mr. McIntosh said that among 1,000 steel cars on the Central Railroad of New Jersey, thus far the necessity for repairs was limited to wrecks, but the time would come when special shop facilities, with cranes, would be required.

Standard Axles.

Mr. Nelson considered the drop test the most important factor in the testing of axles. With reference to deflection under the drop he was led to believe stiffness in axles a desirable feature. Segregation in axles is guarded against by cutting off about 25 per cent. of the top of the ingots. Out of 65,000 axles made to the Pennsylvania specifications only two broke under test. It is understood that one axle is selected to represent 100 axles in the test. This report was submitted to letter ballot.

Draft Gear.

Mr. Quereau doubted the value of drop tests in comparing draft gear. The committee stated in their report that the yoke rivets were sheared in the tests because of the light weight striking at higher velocity. The drop weight did not at all represent the action of cars coming together. A drop weight of 1,640 lbs. dropping, as in the test of 30 ft., was moving at about 30 miles per hour. A car of 20 times this weight acted differently on draft gear. Friction gears were designed for cars. They operated best when allowed appreciable time to act, as in trains. The speaker also called attention to the effect of the preliminary spring in the friction gears. The recoil of these tests was really only a measure of the action of the preliminary spring. The recoil was very different in service with cars. These matters had not been mentioned by the committee. Mr. Chamberlain disavowed the intention of criticising the committee, but virtually discredited the report because so little information was given as to the construction of the gears tested, and no assurance, except in a single case, that of the Miner, that the construction was such as is usually furnished for service. The applause indicated that he was supported by the members. Mr. Sanderson defended the drop test, on the basis of its satisfactory use in connection with axles. Mr. Quereau agreed that the drop test might be very satisfactory in comparing materials and construction, but too much importance could be given to these tests in drawing conclusions requiring comparisons. Mr. Waitt commended the work of the committee, which had brought the subject forward, as a beginning of improvement. This led to a motion to continue the committee and commend their work.

Side Bearings and Center Plates.

This committee wished the report to be considered as one of progress, and suggested continuing the subject for definite recommendation next year. This was provided for.

Cast Iron Wheels.

Mr. G. L. Fowler had recently inquired into the reported difficulties with breakage of cast iron wheels. He found that there was little trouble on level roads. Cracks lengthwise of the tread had occurred frequently, and this was overcome by increasing the thickness of the metal. Recently a new form of transverse cracks had appeared. By experiment these cracks had been produced by the thermal test, which would seem to indicate that they occur in service as a result of the heating by the brakes. The speaker believed that cast iron wheels had now developed, in both design and material, to such a point as to lead to complete confidence in them for use under heavy cars. The committee was continued.

Outside Dimensions of Box Cars.

Mr. Appleyard presented this report. Mr. Quereau commented upon the importance of co-operation in connection with such important improvements as the standard car. This association had now an opportunity to carry out a great work in connection with, and under the direction of, the American Railway Association. He directed attention to the fact that the report omitted recommendations with reference to the outside length of the car. The committee had demurred with reference to the size of the door opening. Mr. Quereau clearly brought before the association the facts that the width of the door is established and that the association is expected to provide for the standard size of the door and to establish the outside length. Mr. Waitt showed that it had taken ten years to establish the standard inside dimensions. It was wise to accept the report as one of progress and take up the work more completely, rather than to take hasty action now. The committee was continued.

The Committee on Standard Pipe Unions was continued.

A verbal report of the Committee on the Revision of the Car Builders' Dictionary was made, and the members were urged to co-operate with the *Railroad Gazette*, the publishers, in this work.

Mr. Canfield presented, as a topical subject, a comprehensive and interesting review of the state of the art in car lighting. He compared the costs of the various systems, and we shall print an abstract of his paper. This being an important subject it will be reported upon by a committee next year.

The election of officers resulted as follows: President, J. W. Marden; vice-presidents, F. W. Brazier, W. P. Appleyard, Joseph Buker; treasurer, John Kirby; secretary, J. W. Taylor; executive members, L. T. Canfield, H. F. Ball and S. F. Prince.

Adjourned.

MASTER MECHANICS' ASSOCIATION.

THIRTY-FIFTH ANNUAL CONVENTION.

The convention was called to order by President Waitt and opened with prayer by the Rev. T. F. Chambers, which was followed by an address of welcome by Mr. Knapp, president of the village of Saratoga. President Waitt's address was one of the ablest, most comprehensive and suggestive of possibilities of improvement of the motive power department that has ever been delivered before the association. He said in part:

"The past year has been one of uninterrupted progress and prosperity in all lines of business, so much so that the railroads of the country have been taxed to their utmost capacity to care for the enormously increased traffic, and our newspapers have been continually compelled to chronicle a car and motive power famine.

"Statistics compiled for the year 1901 showed the total output of the eight principal locomotive building plants of this country as 3,384. This was the largest output on record, and is 7 3-10 per cent. more than in 1900. For the year ending June 1, 1902, the record of locomotive building has exceeded even the year 1901. The reports of five locomotive manufacturing companies indicate an output of 3,638, which is a total result beyond what has ever before been reached. Of the locomotives about 540 were for passenger service, 2,380 for freight service, and the balance for switching and miscellaneous uses. Eighty per cent. were for use of bituminous coal; 10 per cent. for anthracite, and the balance, 10 per cent., for oil or other fuels. Of the bituminous coal burning standard gauge engines, about 50 per cent. were constructed with so-called wide fireboxes, extending beyond the outside of frames. During the past year about 30 per cent. of the total of passenger and freight engines built by the two largest locomotive manufacturing companies were of the compound type. The heaviest engine built during the past year weighed, not including the tender, 267,800 lbs., 237,800 lbs. of which were on the driving wheels. This was a locomotive of the decapod type, built for heavy service on the Atchison, Topeka & Santa Fe Railway.

"The past five years have shown a wonderful development in the main features of locomotive design and construction. No longer ago than 1897, passenger engines with 2,200 ft. of heating surface, and freight engines with 2,900 ft., were spoken of as marvels of progress, and comment was made at that time of the fact that boiler pressures were being raised to above 150 lbs., and might possibly reach 180 lbs. on simple locomotives. The past year engines have been constructed for passenger service with over 3,500 ft. of heating surface, and freight engines with 5,390 ft. Most of the simple engines constructed carry 200 lbs. pressure, and some have been designed for 225 lbs. At the present time it seems to be a conceded fact that with 200 lbs. pressure the economical limit for simple engines has been reached, and that for higher pressure the compounding feature is necessary for economy in fuel consumption.

"During the past two years the limitations of the two-cylinder compound engine have been reached and passed. The required dimensions for the low pressure cylinders for two-cylinder type on the heavy engines of recent construction exceed

the possible clearance limits for side tracks and switch stands, and the space between the necessary location of the center of cylinder and top of rail. In the present state of the art two alternatives seemed to be presented, namely, the tandem or the four-cylinder compounds, both of which types have enthusiastic adherents and ardent opponents.

"All efforts of the executive officers of our railroads have the object in view of increasing the difference between the cost of operation and the revenue received for handling traffic. To my mind there are several lines of action for advantageous consideration in which the motive power department officials can materially assist in bringing about a decrease in operating expenses and an increase in efficiency of operation.

"Prominent among these I would name 'System and Organization' in department work. The past two or three years has done much toward bringing many lines having independent organizations into more close business relations than heretofore. This has been brought about by consolidations, leasing, purchase, or as a result of the merging or a 'community of intrests.' The result of such moves is to bring about a more uniform general policy; to give better service to the public; to standardize methods and equipment, and to reduce friction.

"In many cases this has given to executive and operating officers a more extensive jurisdiction and larger duties, and has imposed burdens upon them that call for the establishing of a carefully worked out system and thorough organization for conducting the business delegated to them, if the desired results are to be obtained. Success, in small matters, may be possible without the necessity for inaugurating system, as in such matters an officer may be able to divide his time and presence so as to come in personal contact with much of the detail, but in large affairs, embracing much territory and many men, an executive officer cannot go much into detail, or be in frequent personal contact with but few points.

"In handling large business propositions the executive officer must, in order to be successful, inaugurate a thorough system, and he must gather about him an organization of efficient helpers. These subordinates must be of such a character that they can each be relied upon to carry out the part of the systematized work delegated to them, and present to their chief in command such summaries of results as will keep him thoroughly posted as to the work accomplished. These reports should be of such a character as to enable the chief to quickly locate weak points in either the system or the organized force for carrying out the system, so that such weak points can be strengthened by personal contact. Scattered efforts are most often futile. Concentration is needed for success in large matters.

"Any system, to be successful, must clearly define duties and the measure of responsibility, so that if a failure occurs there will be no doubt as to who is to be looked to for an explanation, and who is responsible. Lack of a good system, or absence of a reliable organization, cause many executive officers to carry burdens and worries which could be readily avoided. Better results could be more rapidly obtained with the expenditure of a little more money for efficient subordinates, enabling the chief to take more time for planning and systematizing the work, and less for the detail that could be done just as readily by assistants.

"In 'Good Shop Practice and Methods' is another source of money saving for railroads. There should be a sufficient number of foremen to properly supervise the quantity and quality of work. The average grade of mechanics, in many of our railroad shops, is considerably below the standard in general manufacturing lines. Although the work is generally more steady and continuous the year round, yet on account of the average pay being less it is found that at certain times of the year, manufacturing shops, outside, can hold out better temporary inducements, and the men are willing to take chances of being able to return to the railroad shops when the outside business is dull. It is almost always the better class of men that leave. As a result of the poor average grade of mechanics, much work is spoiled or poorly fitted, requiring more work in setting up, and giving poor results in service. Much poor work from poor mechanics has to go to the scrap pile. Some way of inducing the better grade of mechanics to seek railroad shop service, and to remain in such service, is desirable. It is noticeable that in shops using the piecework system, if it has been introduced in a fair and liberal spirit, the best grade of men remain in service, and the poorer ones leave voluntarily. Piecework is a boon alike to the shop superintendent and to the good mechanic, as it gives the mechanic a much higher net pay per month, and relieves the foreman from having to rush the men in order to get the proper quantity of work turned out.

"In introducing piecework it must be done with absolute fairness, and in a manner to show the mechanic that if he maintains a fair output, he is guaranteed the equivalent of his day rate of pay, and is given the privilege of greatly increasing his wages by means of an increased output, and will not be curtailed because he puts in unusual efforts, and draws high monthly pay. A piecework basis should be made clearly advantageous to the mechanic, while retaining part of the benefit for the company. A price should be carefully established, and it should be understood that when it is established it will stand for three, or, better, six months, before revision, unless some material change is made in the tools or facilities for getting out the work. In revisions of prices an equal division may properly be made between the mechanic and the company.

"Above all, straightforwardness and fairness, by all concerned, is necessary to success in introducing a piecework system, or any new system affecting relations between the employer and employees.

"Much can be done in reducing loss in operation by furnishing good, modern tools, and keeping them in good condition. Experiments with higher grades of tool steel will, in many shops, enable the speed of running the machines to be doubled, or greatly increased, thereby giving much larger output. Greatly improved results can be obtained by giving attention to proper grinding of tools, and proper setting in the tool post.

"Care in the selection and purchasing of good material, under carefully prepared specifications, will reduce to a minimum the loss from poor material, and will increase the wear of the parts made.

"As has been frequently stated, the cost of coal consumption is the largest single item of expense that the motive power department has to deal with. In order to handle this question to the best advantage, it is necessary to make a careful study of the production and treatment of the coal in detail from the mine to the tender. On many large systems the work of an A1 man, as a specialist, devoting his time to a study of the quality of coal and its handling, would, without doubt, effect a saving of from 5 to 10 per cent.

"It is a known fact that the size of locomotives of recent design is such that the limit has almost been reached for the capacity of a single fireman to properly fire the engines. If any further increase in the size of the firebox is contemplated, it may be necessary to install an automatic method of stoking. In many of the engines put in service during the last three years an automatic stoker would, undoubtedly, be the means of considerable economies in the burning of coal.

"In 1896 a committee from this association made a report on front end arrangements for locomotives, which has been taken by many of the railroads as a standard for practice for a number of years. The development of the enormous proportions of engines to-day has so changed the conditions of operation that it is evident, from experiments made by some of the prominent members of the association, that the old rules of practice are not applicable to present conditions. The management of the American Engineer and Railroad Journal, seeing that such a condition existed, and that it did not seem feasible at the

time for this association to enter into a somewhat expensive series of locomotive tests, have at their own expense and risk arranged for a careful series of tests being made at Purdue University, to determine for modern front end practice what the fundamental governing rules for draft appliances should be to enable the best and most economical results to be obtained. I desire to commend this work to this association, and bespeak their hearty co-operation, and the financial co-operation of the roads which are represented here."

The report of the secretary showed a total membership of 712, with an increase of 21 active members during the past year. The treasurer's report showed a balance of $2,784 in the treasury.

COMMITTEE REPORTS.

Ton Mile Statistics.

The object of this report was to suggest methods of reporting ton mile statistics and recommend them to the American Railway Association and the American Railway Acounting Officers, the time being ripe for reforming statistics on the rational basis of the ton mile. There was thought to be no opposition to this basis, the question being to fix the method. The report covered only general principles and recommended a series of resolutions, printed elsewhere in this issue. These resolutions were adopted unanimously with too little discussion, and they will be brought before the American Railway Association. The committee was continued to report on details of statistics.

Cost of Running Trains at High Speeds.

Professor Goss said: "It seems to me that if the consideration of this question be narrowed to the locomotive and made simply one of determining how much fuel is required to do work at different speeds, that we are reasonably safe in depending on the results presented by Mr. Delano in the report of last year, which are confirmed by those presented this year by Mr. McIntosh. Assuming the locomotive to be well adapted to the service required of it, if we base comparisons upon time, we shall find that the increase of power, and consequently the increase of fuel, is practically proportional to increase of speed. If we base comparisons upon distance traversed we shall find that the coal required is practically the same for high speed as for low speed; this statement applying within such limits of speed as are now common."

Electric Driving for Shops.

(A paper by C. A. Seley, mechanical engineer, C., R. I. & P. Ry.)

This paper described the application of electricity to the shops of the Norfolk & Western at Roanoke. It is an old shop, recently extended, and the problem was therefore a special one. The author did not favor individual driving in the average railroad shop. Mr. Fowler brought up the question of the economy of the electric drive, which was but a small factor in comparison with the convenience and flexibility of electric driving. In one shop referred to the saving in labor was six times that obtained by the electric drive itself. Mr. Wright (Pittsburgh & Lake Erie) stated that in the new shops at McKees Rocks individual driving was adopted because of the advantage of better speed control. The steps on cone pulleys gave too large changes in speed. With direct driven machines and a wide variation of speeds the adjustment can be made accurately, as well as easily. This would permit also a saving of power. Mr. Seley favored direct current. Mr. T. R. Brown, works manager of the Westinghouse Air Brake Company, briefly described the alternating current system used in that plant. The operation and reliability of these motors had been most satisfactory. Mr. L. R. Pomeroy (General Electric Company) contrasted the problems of a change in an old shop and the equipment of a new one. In an old shop there must naturally be as few changes as possible, the shafting being already in place. He believed that even in the case cited in the paper individual motors would gradually be introduced because of their convenience. He also spoke of the effect of the individual method on the construction of buildings. Without shafting a lighter roof sufficed. He brought out the effect of the power factor on the capacity of generators. Mr. Van Alstine thought there was a lack of definite information concerning the cost of operation of various systems, and suggested the appointment of a committee to present the subject next year. Mr. McIntosh spoke of the new shops of the Central Railroad of New Jersey, where both individual and group driving is employed. Individual driving was a great convenience. Machine builders had yet much to learn with reference to the attachment of motors to machines. Mr. Seley showed that each plant and its conditions must be studied by itself for the best application of electricity. Convenience of transmission of material and parts far overshadowed the small saving made possible by motors. Small tools, he thought, could best be grouped and large tools individually driven by relatively large motors. At Roanoke the standard motor was one of 20 h.p. He had found a lack of information concerning the power required to drive various tools and believed in using a test motor under such conditions as were described in the paper. The discussion was disappointing and was evidently not prepared for in advance.

Topical Discussion.

"Is the Master Mechanics' Association Standard Front End Arrangement Best Adapted to the Modern Locomotive Having Wide Firebox, Increased Length of Flues and Larger Grate Area."—Opened by Mr. John Player.

The speaker called attention to the general use of the Master Mechanics' arrangement. He had found it advisable in large engines to increase the usual distance between the flue sheet and exhaust pipe. The adjustable diaphragm plate gave best results when placed back of the exhaust pipe. The Bell front end was strongly commended as better than the one already referred to.

Professor Goss stated that he thought that changes made back of the front end would probably not affect the arrangement of the front end itself. He directed attention to the diaphragm plate as an obstruction to the draft and raised the question whether it cannot be omitted, as is done in foreign practice. This subject was mentioned in his report on the American Engineer Tests, on page 134 of our May issue. Mr. Quereau believed that the coming front end arrangement would not include a diaphragm, but data not now available would be needed in order to accomplish this.

Mr. Player desired to see a committee appointed to further investigate the proper dimensions for a standard front end, and this led Mr. Quereau to direct attention to the American Engineer Tests, which had been already referred to by President Waitt in his address, and to offer a resolution authorizing the Executive Committee of the association to assist in the work. This was carried by unanimous vote.

Up to Date Roundhouses.

In the absence of the chairman, Mr. Quayle, this subject was introduced by Mr. Van Alstine. Mr. Quereau did not approve of using but one ash pit at a roundhouse. In order to run engines around others, two pits were needed. Drop pits, he believed, should cover at least three tracks. Sand house construction should be such as to avoid the necessity for shoveling. He emphasized the importance of the organization of the roundhouse force; this was more important than the details of construction or their arrangement. Mr. Gaines raised the questions of the fire risk of wooden smoke jacks and the destruction of the abrasive effect of sand dried by a stove because of driving out the water of crystallization by overheating. Mr. Robb (Grand Trunk) thought it necessary to "burn" sand in order to thoroughly dry it. Professor Hibbard emphasized the necessity of securing the maximum amount of daylight in roundhouses. This had been neglected. Mr. Forney suggested

using the largest possible window area and carrying the glass as high toward the roof as possible.

Improvements in Boiler Design and Proportions of Heating and Grate Surface.

Mr. Gaines, who prepared this report for the committee, presented the subject. This was a discussion by technical men and is exceedingly important in the design of locomotives. Professor Goss approved the report. He desired to see the term "cylinder horse power" substituted for "indicated horse power," unless actual power measured by the indicator is meant. Mr. Vaughan objected to changing the ratio established by the committee of 1897, which gave the relation between the heating surface and cylinder volume. The committee recommended a new ratio in comparing engines. This practically defeated the object of the committee to establish new methods of comparing engines. Mr. Forney asked whether it was possible to get too much heating surface. If not, he asked why it would not be good practice to use as much heating surface as possible. The discussion was closed without action on the recommended comparisons.

"A Typical Shop for 300 Locomotives." (A paper by Mr. L. R. Pomeroy.)

This admirable and suggestive study of present problems in shop practice should lead to others on this subject. Mr. Van Alstine criticised the crane equipment suggested by the author. He considered the crane over the machines the most useful one in the shop in point of actual time in service. Costs of shop work needed more attention. Detailed costs of parts, such as staybolt accounts, were valuable. When a new tool is applied its effect should be known. Mr. Seley directed attention to the advantages of the longitudinal shops. The objection to the transfer table (for an erecting shop) was not so much a matter of obstruction and snow and ice as to the investment required for a tool seldom used. He was not sure that he would use a 60-ton crane when one of lighter capacity would suffice. Mr. McIntosh defended the transfer table.

Standard Specifications of Locomotive Axles.

Mr. Gaines did not find the suggestions of the committee satisfactory with reference to specifications. It was too expensive to sacrifice entire axles for test. This might be overcome by using an extension of an axle or a "witness piece" for the purpose. Hammer or forging press work should bear some relation to the volume of the metal worked. The subject was continued, and representatives of the locomotive building companies will be added to the committee, with authority to co-operate with the American Society for Testing Materials.

"Helping Engines and Their Performance." (A paper by F. F. Gaines.)

Mr. Quereau stated that the paper showed only the credit side of double heading. Professor Hibbard commended the report specially, because of the recommendations as to designing helping engines, and referred to the article by the author in the June number of the AMERICAN ENGINEER. Mr. Whyte stated that while large drivers were theoretically desirable for hill service, experience on the road was unquestionably favorable to small drivers.

Standard Pipe Unions.

This report was substantially the same as that presented to the M. C. B. Association. The committee was continued and instructed to work with the committee of the other association.

"Modern Water Supply Stations." (A paper by F. M. Whyte.)

This is an exceedingly well prepared and comprehensive paper, which cannot fail to bring to this subject the attention it deserves. It is an admirable record of the subject and was received with applause. Mr. Gaines and Mr. Vaughan complimented the paper highly, for its value as a record and its satisfactory arrangement. Mr. Vaughan had made experiments which showed that the formula given by Prof. I. P. Church, in his article on page 376, volume 75, of the AMERICAN ENGINEER, was correct. There was very little discussion, as is usual in the case of such papers.

TOPICAL DISCUSSIONS.

"Piston Valves."—Opened by Mr. F. H. Clark.

With an experience with piston valves, dating from 1895, and now having about 150 engines fitted with them, he spoke in high terms of their value. There was, however, room for improvement. Mr. Muchnic referred to the necessity for relief valves, because of the inability of the piston valve to relieve an accumulation of water. This required careful design of relief valves. Leakage of piston valves was mentioned by several speakers as requiring watching. Mr. Gaines spoke of a new balanced slide valve (the Wilson) which is being tried on the Lehigh Valley. It offered all the advantages of the piston valve, and he considered it a step in advance in valve construction. There was an indication of a tendency to question the supremacy of the piston valve.

"Does the Extension of the Smokestack Into the Smokebox Materially Assist in the Steaming of the Engine."—Introduced by Professor Goss.

The speaker stated that his information on this subject was secured in the American Engineer Tests. The results tended to show the importance of high stacks. The stack may be lengthened by extension into the smokebox, and this meant using lower nozzles. The space between the nozzle and the end of the extension might be made 10 ins., and this permitted the use of stacks of considerable length. The extension inside was thought to be as valuable as that outside. By the inside stack the desired length might be obtained, and this permitted a lowering of the center of draft effect, which may result in an adjustment which will make it possible to get along without the diaphragm plate. By the use of the inside stack the efficiency was held up. Mr. Gaines confirmed Professor Goss as to the effect of the inside stack, and also had found it possible by its use to materially reduce the size of the diaphragm.

"Flexible Staybolts."—Opened by Mr. T. A. Lawes.

The cost of flexible staybolts in repairs was much less than of the usual form, as far as the application to which he referred had gone. Mr. West reported very favorable figures for breakages in wide firebox engines. The fireboxes referred to were very wide. He thought the design of the firebox was responsible for much of the breakage. In some boilers of this type, in 12 years of service, bolts longer than 9 ins. had not broken. Mr. Gaines and Mr. Player supported Mr. West. Mr. Player strongly favored wider water spaces. Mr. Miller spoke very favorably of flexible bolts. Mr. Lawes strongly advocated the use of flexible staybolts for engines already built.

The election of officers resulted as follows:

President, G. W. West; vice-presidents, W. H. Lewis, P. H. Peck and H. F. Ball; treasurer, Angus Sinclair; secretary, J. W. Taylor.

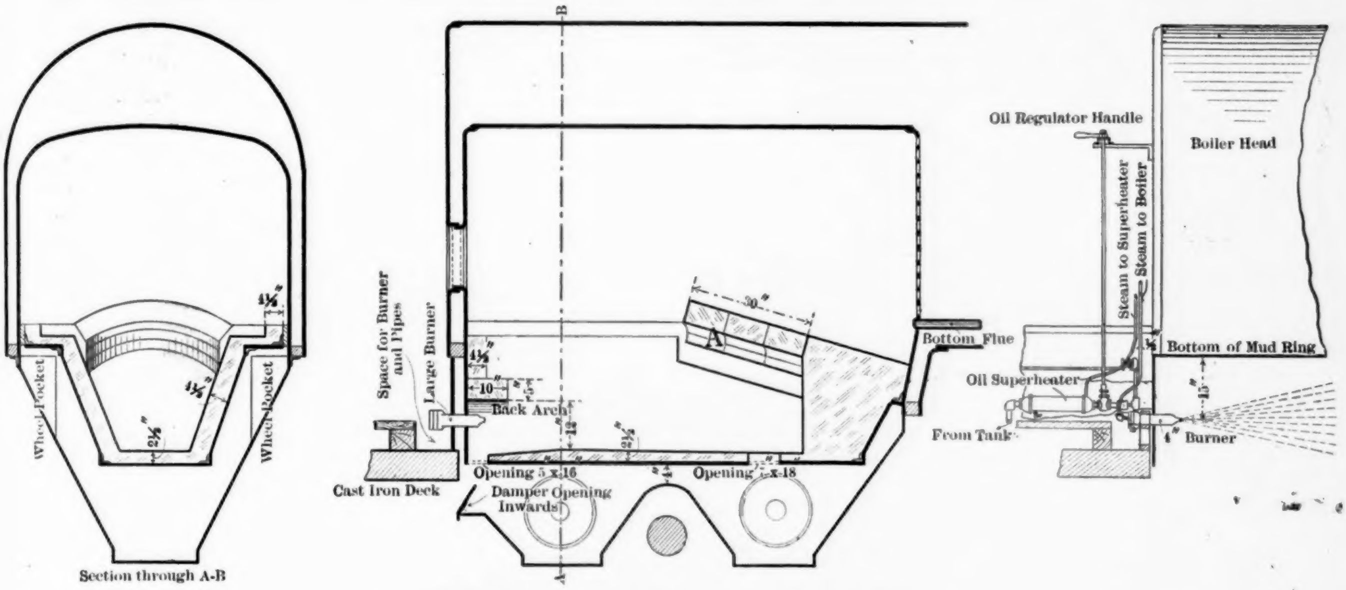
Purdue University has now in process of erection a temporary building for the accommodation of its collection of historic locomotives. The building is 60 by 64 ft., and contains four tracks, three of which are already occupied by locomotives. The list includes the "James Tolman," an engine of English design; the Baltimore & Ohio engine No. 173, known as a Hayes Ten-Wheel "Camel," and a 16 by 24 in. American type engine from the Chicago & Northwestern Railroad. It is understood that the university very much desires to obtain an inside-connected engine which it can add to its collection.

A cement for pipe joints that is said to be as good in a faced or rough flange joint as red-lead putty, at one-tenth the cost, consists of a mixture of ordinary pine tar and dry oxide of iron. At a recent meeting in Columbus of the Ohio Gas Light Association its use was recommended by Mr. George Light, who stated that it does not harden as soon as red lead, and is very adhesive under pressure.—Engineering Record.

THE USE OF OIL FUEL ON THE SOUTHERN PACIFIC.

By P. Sheedy, Master Mechanic, Southern Pacific Railway.

The success of the use of fuel oil on locomotives in the Southwest cannot better be attested than by the increasing introduction of oil burning upon the locomotives of the Southern Pacific Railway system. The company has at present nearly 250 locomotives equipped for oil burning, and the results of this fuel have so far been quite satisfactory; indeed, so satisfactory has it proved that standard designs of burners, piping connections, bricking and arch arrangements, front-end arrangements, etc., have been originated and adopted by the management.

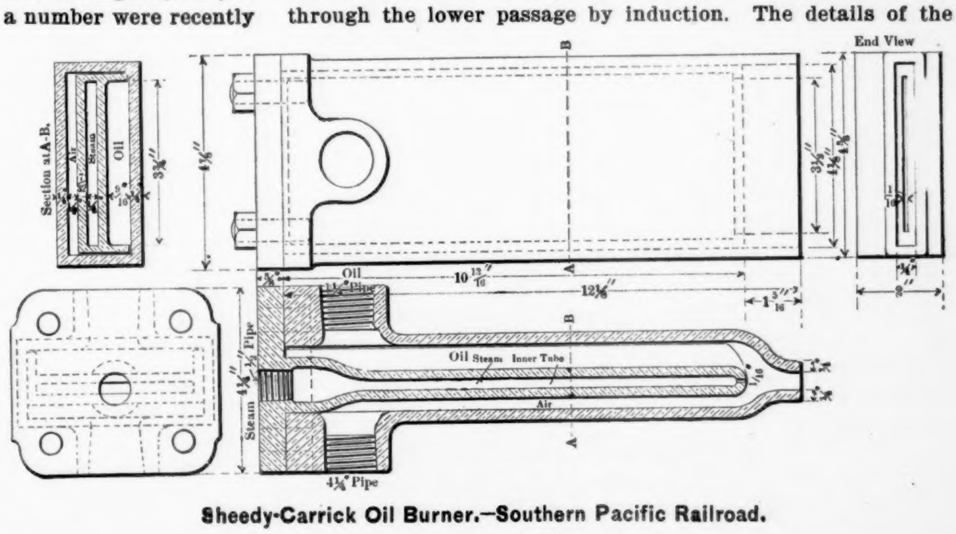


Firebox Setting for Fuel Oil—Southern Pacific Railway

The accompanying drawings show the arrangement of the burner and piping connections, the front-end arrangement and the details of the burner, of the class D-Z engines recently equipped at the Southern Pacific shops at Los Angeles, Cal., to burn fuel oil. These engines, of which a number were recently received from the Baldwin Locomotive Works are Vauclain compounds, built for heavy passenger service, having boilers of the wide firebox type, carrying a working pressure of 200 lbs. per sq. in. As may be seen in the sectional views of the firebox, there is an inside pan arrangement, constructed inside the ash pan proper, to support the brick lining and arch. This inside pan, which is made from ⅜-inch boiler steel, is well stayed and substantially made, and is suspended from the studs that formerly held the side bars for the coal grates. This method of supporting the arch places the burner and brickwork so low that almost the entire heating surface of the firebox is exposed to the hot gases, the only surface covered being where the brickwork is extended up to protect the rivets in the mud ring. The burner is located 15 ins. below the mud ring, and directs its spray under the arch, A, from whence the flame spreads back and distributes itself very evenly through the firebox and tubes. The admission of air is regulated by a damper in the back end, and winker dampers on each side of the two hoppers in the bottom of the ash pan proper. Also, some air is admitted through the burner itself, as may be seen from the sectional view.

The standard front-end arrangement, which is shown in section and front elevation, contributes greatly to the even distribution of the hot gases in the tubes. As may be seen, the tip of the nozzle is located half-way between the top and bottom flues, and the flaring edge of the petticoat pipe is 1 in. above it. The top of the petticoat pipe is 4½ ins. below the top of the smoke arch.

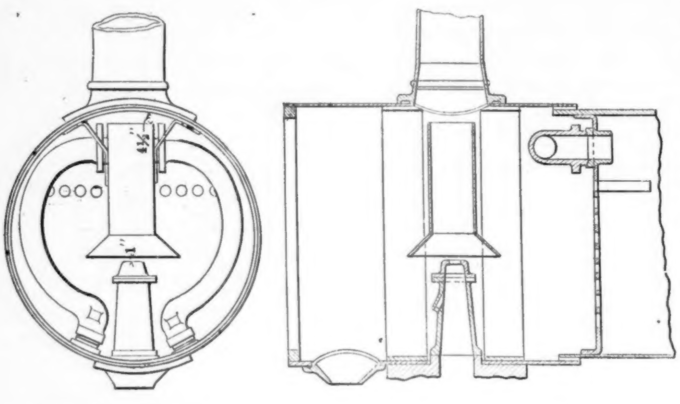
The Sheedy-Carrick burner, which was some time ago adopted as standard by the Southern Pacific system, is the one in use. It operates by induction and gravity combined, and consequently does not require pressure in the oil tank to bring the fuel oil to it. The drawing of the burner shows its construction diagrammatically and in section. The oil enters from above, flows out and down over the orifice, or slit, from which the steam issues, where it is atomized and blown into the firebox. Air is also permitted to flow through the burner through the lower passage by induction. The details of the burner are clearly shown in the drawing, which indicates the construction whereby the inner, or steam, tube may be easily removed from the burner casing. The arrangement of the oil and steam piping connections is shown in the boiler head view, which shows also the oil superheater connected in the oil delivery near the burner.



Sheedy-Carrick Oil Burner.—Southern Pacific Railroad.

Engines equipped with this burner arrangement burn a steady, smooth flame, free from disagreeable explosions, or

the drumming so common to oil-burning locomotives not properly equipped. They steam splendidly, and with ordinary care on the part of the fireman will not show a trace of smoke. The burner shown in the diagram is of ample size to handle the firebox of a class D-Z engine, or, in fact, any larger size of firebox. This view shows, of course, an arrangement for



Front End Arrangement—Oil Fuel on Southern Pacific Railway

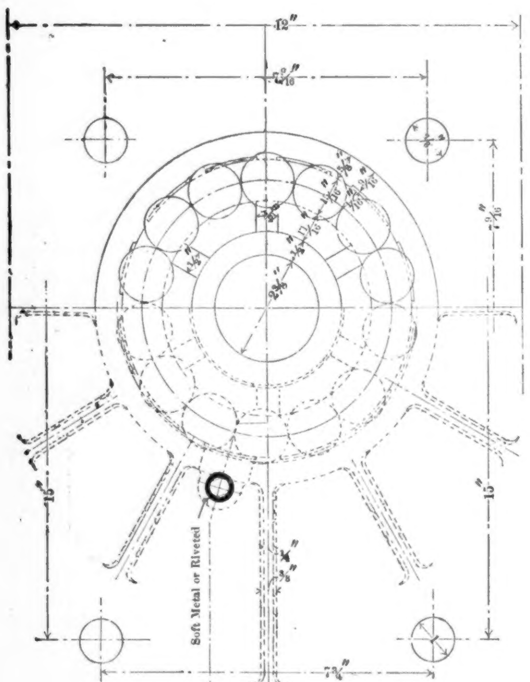
one particular class of engine, but all kinds of engines have been equipped on this road for oil burning, from the smallest narrow-gauge motors to the largest engines with Wootten fireboxes. Also, some of the locomotives equipped with Vanderbilt boilers are burning crude oil, and have given very good satisfaction up to date.

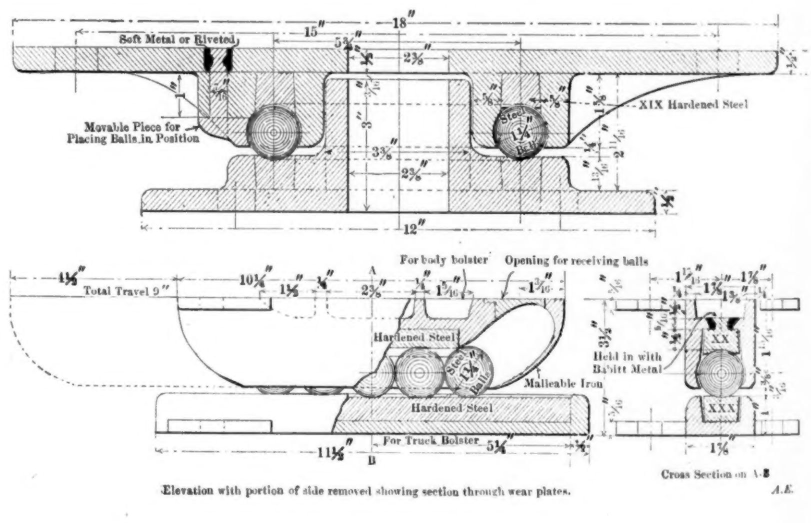
A symposium on the locomotive piston valve, published in the special convention issue of the *Railway and Engineering Review*, is the most complete and satisfactory treatment of the subject available anywhere. It includes the construction of the valve, the form of packing rings and the advantages derived from the perfect balancing which this valve permits. The discussion includes reports of experience and statements of preference in design and construction from a number of well known motive power officials, bringing the subject up to date in an admirable way.

THE NORWOOD SIDE BEARINGS AND CENTER PLATES.

The Norwood ball side bearings and center plates developed from a desire to provide means whereby trucks should be made to curve easily in order to avoid accidents due to the resistance in curving and the severe wear of wheel flanges, which is unavoidable with ordinary construction. The advent of the large capacity car increased and added to the difficulties which formerly existed, and the time has come to consider devices of this kind as necessities. Many railroad officers are ready to apply so-called "frictionless" side bearings and centerplates when they are sure of having found trustworthy devices.

Mr. Norwood selected ball bearings as the simplest and most satisfactory solution of the problem. To avoid accumulations of dirt it was necessary to suspend the balls in such a way as to insure its escape from the bearings. Simplicity was the next desirable feature. It was also necessary to avoid springs or other centering devices. These bearings, both center plate and side bearings, have been developed into the construction shown by these engravings, in which there are no bolts or nuts and no loose parts except the balls. The balls are 1¼ ins. in diameter, of the best tool steel, ground and hardened. They have been tested in bearings with loads of 25 tons per ball without signs of failure, and they should wear a long time. Special low carbon steel, case-hardened to a depth of from 1-16 to ⅛ in., is used for the ball races, and these are cheap and easily renewed in case of wear. The castings are simple and the metal is favorably placed. In order to resist





Norwood Side Bearings and Center Plates.

lateral motion, and avoid the difficulty from the wear which it would cause, the ball race grooves are deep, giving arcs of bearing surface amounting to about one-third of the circumference of the balls. This also distributes the load on the balls; they will last much longer than if loaded on points only, as they would be if the races were flat or V-shaped. The resistance to lateral motion is considered one of the advantages of balls over rollers.

The side bearing is shaped to return the balls so that they will be kept in a central position by gravity. They are introduced into the casting through a hole at one end, which is fitted with a cover riveted in, and the ball race of the upper bearing is held in place by a projection which is sealed with melted babbitt or lead. This fastening bears no strain, and merely holds the race from dropping out. The lower race is forced to a level bearing by hydraulic pressure. With five balls 9 ins. of motion is obtained, with an upper race only 4¾ ins. long, two of the balls always being out of service, with a space at each end of the bearing into which they may travel.

This construction permits of using a small number of balls. For heavy tenders, ten balls are provided, in two parallel races, the seat for the lower race being curved in section, to be sure that both sets of balls come to a bearing.

The center plate employs the principle of the side bearing, the balls being introduced through a hole which is closed by a loose piece secured by a lead seal. To guard against lateral displacement, the races are grooved and the lower casting projects into the center of the upper one, as in the center plates described by Mr. C. A. Seley in our March number, page 75. Double ball races have been applied to the center plates also, but these are unnecessary, except under the heaviest special equipment. These bearings may be made to fit any bolster, and for such service as the standard Pullman trucks special designs are made. This company has also completed cast-steel body and truck bolsters, each cast in one piece, including the cast portions of the bearings. It is an attractive design, which was exhibited at Saratoga.

A recent test to show the power required to turn the plates with increasing pressures under as nearly service conditions as possible, showed the following results:

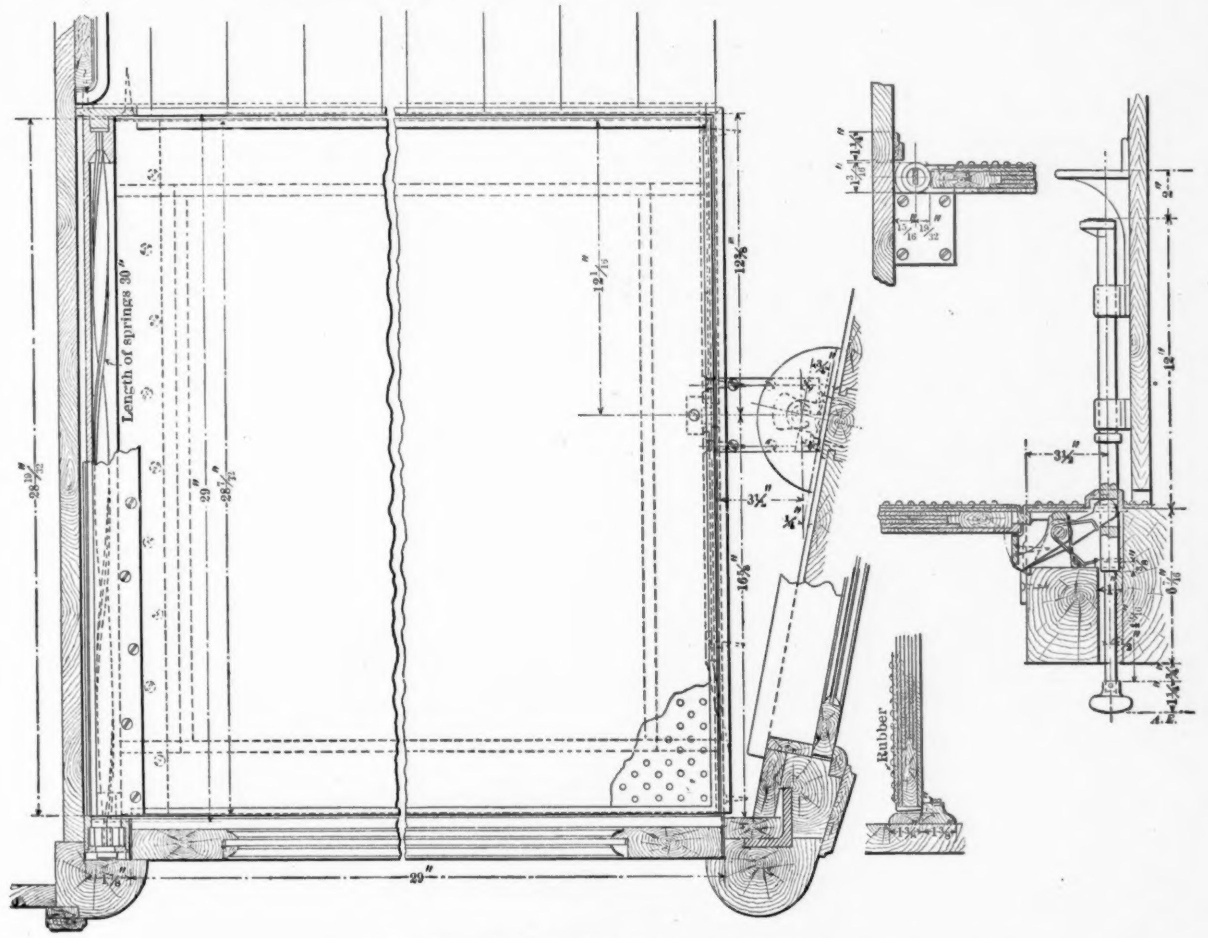
Load in Pounds on Center Plates.	Pounds Applied to 35 inch Lever from Center Pin.
10,000	10 to 20
20,000	10 to 30
30,000	20 to 35
40,000	20 to 59
50,000	30 to 50
60,000	40 to 60
67,000	60 to 75
70,000	70 to 90

This test of ball-bearing center plates was made by the Baltimore Ball Bearing Company under a Riehle upright press, using a lever 35 ins. long from the center of the center pin to show the power exerted by the flange of the wheel to turn center plates under a 100,000-lb. car.

The subject of friction-reducing side bearings and center plates has been so thoroughly dealt with in this journal as to render a review of the arguments unnecessary, but it may be said here that one is incomplete without the other, and both should be applied. These bearings are manufactured by the Baltimore Ball Bearing Company, Calvert Building, Baltimore, Md., from whom further information may be had.

THE EDWARDS EXTENSION PLATFORM TRAP DOOR.

Because vestibules have become a necessary accompaniment of modern passenger equipment, the trap doors which must be used with them, and must be opened often, have become important items of construction. An ingenious arrangement has been developed by the O. M. Edwards Company, of Syracuse, N. Y., and is now in use on many of the leading railroads. It has proven itself an inexpensive and successful device.



The Edwards Extension Platform Trap Door.

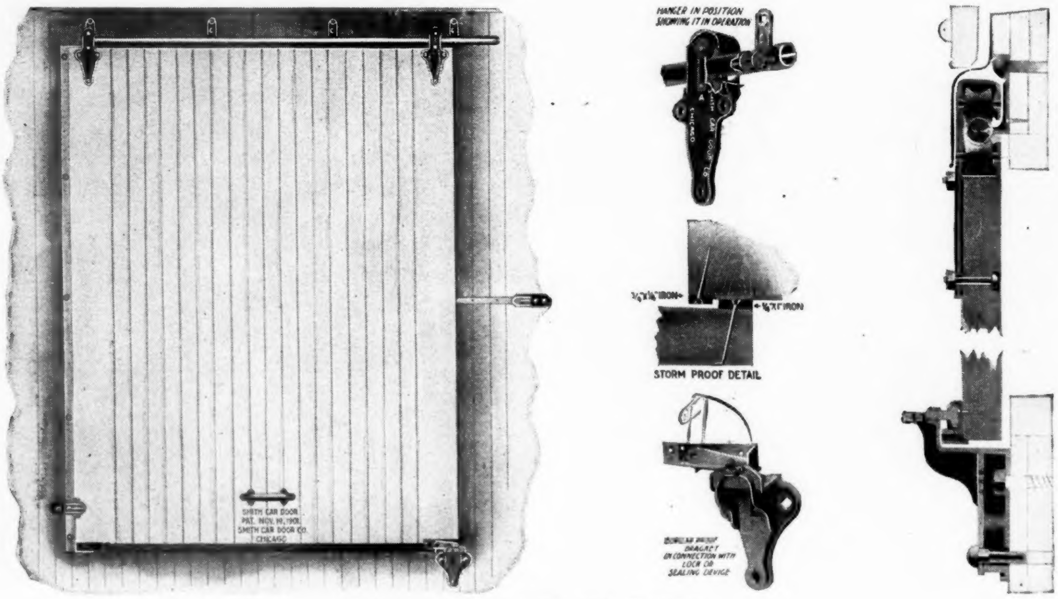
As shown in the engraving a hinge extends the entire width of the door, through which passes a torsional spring, consisting simply of two flat steel bars. This spring is fastened at one end in the hinge and at the other end in a ratchet wheel located in a bracket, which is fastened in the corner post of the car. By means of this ratchet wheel the torsion in the spring may be regulated to open the door automatically to a full open position or to a semi-open position, as desired.

The door is operated by means of a foot lever pin, located in the front end of the vestibule, and protected by the usual signal step, which is fastened in the end of the vestibule. By pressing down on this pin with the foot, the lock bolt is withdrawn from the keeper in the door and allows the door to open automatically. As soon as the lock bolt is fully withdrawn, the lever, which is shown in the sectional view of the platform and door, is brought up against the under side of the door, and should the door stick, forces it past that point where it cannot be bound by the platform. This lever does away with the usual handhold in the door, which has been found ob-

jectionable by some railroads, as it is a receptacle for water and dirt. If desired, the door can also be operated from the outside of the car by a short pull-rod, which is screwed into the lower end of the foot operating pin, and projects through the end sill of the platform just far enough to allow the knob on the end of the pull-rod to be handled easily in opening the door.

THE SMITH CAR DOOR.

As shown by this engraving, the Smith car door, which is controlled by the Jones Car Door Company, of Chicago, has a number of interesting features. The track is steel tubing of 14 gauge and 1 5-16 ins. in diameter. It has a ⅝-in. slot in the back, permitting of using supports having two knobs 1½ ins. apart. These render unnecessary the usual furring strips. Each hanger has two rollers, one above and the other below the track. These hold the door to the track, and it cannot fall off after being hung. The use of loose axle wheels is also an advantage. At the lower right-hand corner of the door is a combined lock and sealing device, with a burglar-proof bracket. It is burglar proof because the lag screws are covered and the carriage bolts cannot be turned by their heads, which are outside. A storm-proof detail is added in the form of a ¾ by ¼-in. iron strip on the door post and a ¾ by 1-in. strip on the back of the door. The strip on the door bears on the rub iron on the car, and when the door is closed the two vertical strips make a storm-proof joint. An 8-in. steel hood covers the rail and the upper joint of the door. The engraving illustrates the construction of the door. Further information may be had from the Jones Car Door Company, 234 La Salle street, Chicago.



The Smith Car Door and Fixtures.

We are pleased to learn that the University of Wisconsin will again conduct their Summer School for Apprentices and Artisans this summer, from June 30 until August 8. This school is intended primarily to give to stationary engineers, superintendents of power stations, machinists and apprentices in various trades such mathematical, laboratory and shop instruction as would be found of most practical value to them and which could be imparted in the limited time of six weeks. Any person over 16 years of age, speaking the English language and having a fair knowledge of arithmetic, will be admitted. The school has a faculty of ten, composed of the regular professors and instructors from the faculty of the College of Engineering of the university. Correspondence school students will find the opportunities for laboratory and shop work offered here particularly helpful.

The courses of instruction are: The use of Formulæ; Mechanical Drawing; Steam Engineering; Applied Electricity; Transmission of Power; Strength of Materials and Shop-work in Carpentry, Forging and Machine Tools. The tuition fee has been placed at the moderate sum of $15 for all courses for the term, in addition to which 5 cents per hour is charged for all time spent in the laboratories at practical work.

The school was started last year as an experiment and has proved eminently successful, as has been shown by personal indorsements of those who took the courses. This school is not self-supporting, as the fees pay but a small portion of the expenses; the remainder is paid out of the general university funds.

GROWTH OF THE PINTSCH LIGHT SYSTEM.

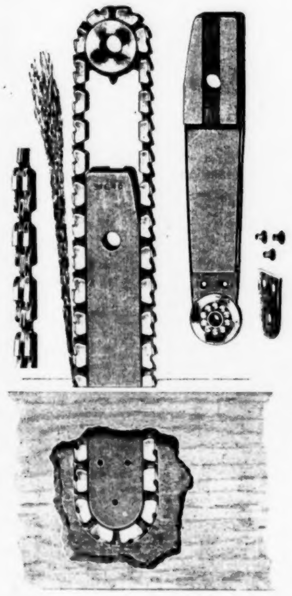
An interesting statement has been issued by the Safety Car Heating & Lighting Company, showing the remarkable increase in the use of the Pintsch light system during the past twelve months, as well as giving the total number of cars, locomotives, buoys and beacons equipped with this system throughout the world. Upon reference to the table, we find that there are at present in the United States and Canada 18,663 cars equipped with the Pintsch system, while in the territory controlled by the American company there are sixty-six Pintsch gas manufacturing plants in operation. The statement complete to May, 1902, appears below:

	Cars.	Locomotives.	Gas Works.	Buoys and Beacons.
Germany	40,156	4,786	71	124
Denmark	45		3	21
England	18,859	18	87	272
France	6,741	....	27	240
Holland	3,487	5	10	86
Italy	1,528	....	5	15
Switzerland	380	2	1	....
Austria	4,218	....	10	1
Russia	3,041	112	13	13
Sweden	679	43	4	2
Servia	216	....	....	....
Bulgaria	98	....	1	....
Turkey	114	....	...	....
Egypt	42	....	3	118
Canada	166	....	3	65
Brazil	974	31	1	33
Argentine	1,096	....	10	2
Chili	46	....	2	....
India	9,584	....	16	....
Australia	2,053	....	13	38
United States	18,497	....	63	172
Japan	100	....	2	4
China	.....	....	1	15
Mexico	81	....	1	....
Total	**112,191**	**4,997**	**347**	**1,211**
Increase for the year	**6,527**	**525**	**11**	**49**

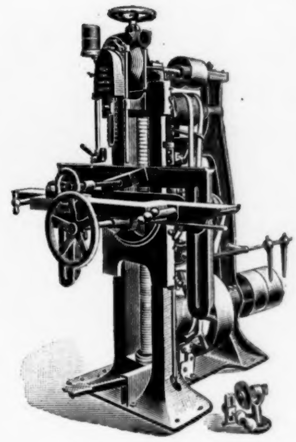
CHAIN SAW MORTISER.

The chain saw mortising machine shown herewith, which is made by the New Britain Machine Company, New Britain, Conn., is a distinct advance in the field of woodworking machinery. As shown in detail view of the chain mechanism, mortising is done by a sprocket chain, each link of which carries a sharpened cutting tooth so formed as to carry out its own chip. This chain is driven by a sprocket wheel arranged in the head of the machine and in the cutting portion of its travel slides down around the grooved guide bar, having the roller bearing guide wheel at the bottom. Chips are carried away by a rotary fan on the sprocket shaft on the head.

This arrangement permits a very gradual, even cutting action, as with the ordinary chain speed of 1,500 ft. per minute, 40,000 cutting teeth are presented to the work in that time; likewise for the same reason very rapid work may be done, as high as 120 door stiles mortised per hour being possible with



Details of Chain Mechanism.



Chain Saw Mortiser.

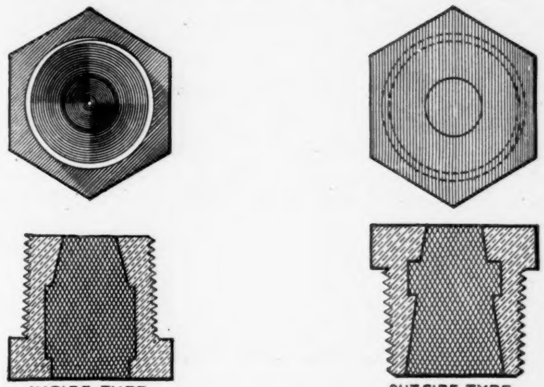
this machine. The range of sizes of mortise possible with one setting of the work is from ¼ x 1½ ins. up to 1 x 13 ins., and any depth up to 6½ ins., greater sizes being of course possible by readjusting the work. It is claimed to work equally well in all kinds of wood, hard or knotty, including the "fattest" Georgia pine. Taper mortises may also be cut by providing special taper chain-guide bars, and the table may be tilted for angle mortises.

This machine is furnished in two sizes, each for heavy and light work, in the form of an adjustable gang mortiser, and also with a special hollow chisel attachment for very deep mortises and special work. The New Britain Machine Company will be pleased to furnish information regarding these machines to anyone interested.

The passenger department of the Boston & Maine Railroad has issued the first of a new series of folders describing picturesque New England. By means of maps, routes, rates and lists of hotels and boarding houses a complete trip may be planned and accommodations secured in advance. The territory covered is unsurpassed; it includes the White Mountains, Mount Desert, the Adirondacks, Catskills, Montreal, Quebec, the beautiful lake regions and the beaches of New England. All this is covered in a single large folder, which is admirably arranged. The folder cannot be carefully examined without stimulating a desire to visit all of the attractions which it describes. It is a directory to all of the summer resorts of New England.

APPROVED FUSIBLE PLUGS.

The United States Treasury Department recently took action, in view of a disastrous boiler explosion at Philadelphia last fall, to enforce Section 4,436 of the United States Revised Statutes regarding specifications for fusible plugs for boilers, and have issued a circular specifying that all fusible plugs shall be filled only with pure Banca tin and stamped with the name of the maker, and requiring an affidavit setting forth this fact to be filed with the local boiler inspector wherever the plug is used. The Lunkenheimer



INSIDE TYPE   OUTSIDE TYPE

Company, Cincinnati, O., have for some time manufactured fusible plugs fully complying with these specifications, and have recently made an affidavit before the United States Steamboat Inspection Service to that effect. The accompanying illustrations show sections and plan views of both the inside and the outside types of the plugs which they make.

PERSONALS.

Mr. J. W. Storey has been appointed chief draftsman of the mechanical department of the "Q. and C." Railway, at Ludlow, Ky.

Mr. W. C. Ennis has been appointed master mechanic of the Pennsylvania Division of the Delaware & Hudson Company, to succeed Mr. Robert Rennie, who recently resigned.

Mr. S. Higgins has resigned as superintendent of motive power of the Union Pacific, and has been appointed superintendent of motive power of the Southern Railway, to succeed Mr. W. H. Thomas, who has recently resigned.

Mr. W. R. McKeen, Jr., has been appointed to succeed Mr. S. Higgins as superintendent of motive power of the Union Pacific. He is a graduate of Rose Polytechnic Institute, and began his railroad service as a special apprentice, and in 1893 was appointed master mechanic on the Union Pacific at North Platte, Neb., having held this position until now.

Herr A. Von Borries, one of the best and most favorably known locomotive authorities, who has for years held the position of Regierungs und Baurath, Prussian State Railroads, has been appointed to a professorship in the Imperial High School at Berlin, where he will have charge of the subject of railroad equipment. A great deal of scientific work of most valuable character may be expected from his connection with this school, and it is not too much to say that instruction and investigation concerning locomotive subjects could not be placed in better or more competent hands.

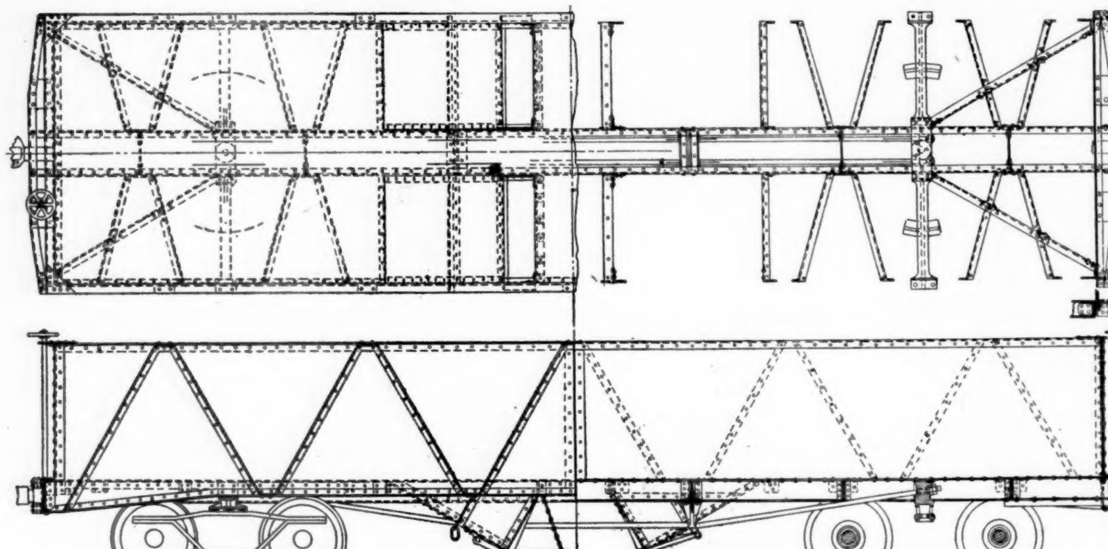
The Pennsylvania Steel Company will have its Northwestern office in the Western Union Building, Chicago, after July 1. It will be in charge of Mr. Clifford J. Ellis, sales agent, and Mr. Robert E. Belknapp, assistant sales agent.

40-TON HOPPER GONDOLA.

Structural Steel Car Company.

The Woodcock steel hopper car of structural steel shapes and plates, which was illustrated in our April number, 1901, was the predecessor of a series of designs which the Structural Steel Car Company, Canton, Ohio, is prepared to build.

The chief feature of the construction of the car shown by this engraving is in the use of the sides of the car to assist in carrying the load. They are plate girders, with diagonal stiffeners of rolled angles at the sides themselves and also the ends and top. At the end sills the sides are brought down to meet the reverse angles and T-bars which form the connection between the end plates and sills. The end sills are built up of angles and plates, and the center sills are trussed channels, with corner bracing of angles, as shown in the floor framing plan. The effect of this is to give the car a stiff backbone, almost equivalent to a box girder. At frequent intervals the center sills are braced by plates, and betwen the bolsters are four floor stiffening members, besides two sets of diagonal braces of angles, the arrangement of the floor supports being intended to secure the maximum possible amount of support with a minimum quantity of material, angles being used for this purpose. The hopper door frames are of channels.


Structural Steel Hopper Gondola Car.

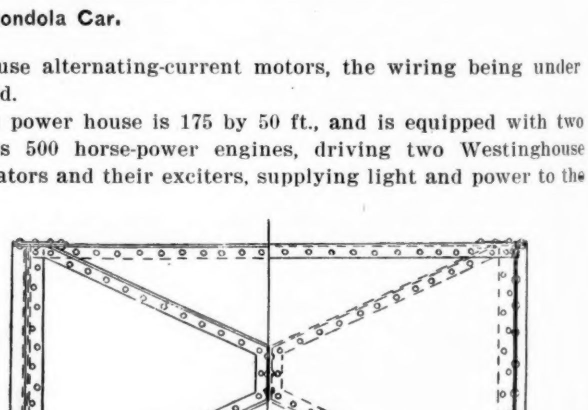
This car has a capacity of 1,600 cubic feet, and its estimated weight is 32,000 lbs. The length is 38 ft.; width, 9 ft. 3 ins.; height, from rail, 8 ft.

The Structural Steel Car Company is now operating its plant at Canton, Ohio, and is ready to build cars, underframes, trucks, bolsters and brake beams, either to its own designs or to those of the purchaser. Rolled steel of standard shapes is used at these works. The location of the plant is favorable for receipt of material and shipment of product, being on the line of the Wheeling & Lake Erie, and the Pittsburgh, Fort Wayne & Chicago railroads. Forty acres of level land were available for the plant, and nearly two miles of storage and repair tracks have been laid down.

The machine and erecting shop is 507 by 80 ft., in a single span, with steel frame and walls of brick and hollow tile. This shop is served by a Pawling & Harnischfeger electric crane, running its full length and extending outside a distance of 150 ft. for the unloading of material from cars and transportation into the shop. Two longitudinal tracks run through the shop, and the car bodies are built on trestles between them. They are handled by the crane when ready for painting and shipping. The shop has a capacity of 50 cars per day, with provision for doubling this output.

The machinery includes plate rolls, a 110-hole multiple punch, with a space of 118 ins. between the housings; two quick-acting double punches, a double-ended punch, coping machines, bending machines for bolsters and sills, all of these machines being the product of the Cleveland Punch & Shear Company. A Scully rotary shear is used to cut the plates. In the truck department is a Watson & Stillman hydraulic press and a Grant axle lathe. All of these machines are driven by Westinghouse alternating-current motors, the wiring being under ground.

The power house is 175 by 50 ft., and is equipped with two Corliss 500 horse-power engines, driving two Westinghouse generators and their exciters, supplying light and power to the entire plant. For supplying air for hammers, drills and reamers in the erecting shop, two Laidlaw-Dunn-Gordon 150 horse-power compressors have been installed in the power house. Steam is supplied by two batteries of vertical water tube boilers, and the power plant also includes fire and feed pumps and feed water heaters.


Half Section and End View.

The forge shop, 75 by 50 ft., contains a 1,000-lb. Bement & Miles drop hammer, an Ajax bulldozer, a set of Ajax brake lever rolls, two Acme forging machines, an Acme bolt and rivet

machine and an Acme threading machine. This shop also has four open fire smith forges and three furnaces for use of natural gas or oil fuel. These are for use with the forging machines.

Both arc and incandescent lighting are used, including 50 2,000-candle-power arc lamps. Artesian wells furnish the water supply. For oil, paints and other supplies, storehouses are provided at convenient locations. For the planning of this excellent plant the company did not find it necessary to call for any assistance to its own engineers, who are men of wide experience.

Electric lighting of cars deriving power from the axle has made material progress, in the opinions of railroad men, during the past year. At the Saratoga Convention the private Pullman car "Columbia," used by Prince Henry of Prussia, on his recent American tour, was exhibited. This car is equipped with electric lights and fans on the system of the Consolidated Railway Electric Lighting & Equipment Company, of 100 Broadway, New York, the car being part of the special equipment of the Pullman Company. It has two large and five small staterooms, an observation and dining room and kitchen. The system is the same in principle as that of the Columbian Electric Car Lighting Company, which has been illustrated in this journal, but under the management of the new company the details have been greatly improved, and a high degree of reliability secured. The Atchison, Topeka & Santa Fe, after a test of 100 new equipments for an entire year, has bought the apparatus outright and taken over its maintenance. We are informed that a private Pullman car recently completed a tour of 98 days in the West and in Mexico without a single failure of any kind in the lighting apparatus. In all this time it received no attention from anyone except the colored porter. It is stated that this system is being applied to all new Pullman equipment. This company either sells the equipment outright or it will be installed and maintained by them at a fixed annual rental. The maximum power required is estimated at about 1½ h.p. per car, or 9 h.p. for a six-car train. Under the management of the present company, of which Mr. John N. Abbott, J. L. Watson and Col. John T. Dickenson are the principal officers, the extension of the system has been rapid, and it has a promising future. In a paper before the Master Car Builders' Association, Mr. L. T. Canfield, of the D., L. & W. R. R., in speaking of electric car lighting, said: "The third, or axle-lighting system, which in my mind is the best system in use to-day, on account of allowing of the free movement of cars, consists of a dynamo or generator driven by a pulley on the axle of the car and the storage battery working in combination with the dynamo, the dynamo charging the battery when the car is running, and the lights not burning, and working in series with the same when the lights are burning."

The Western Manufacturing Company, Springfield, O., had an interesting exhibit of their Champion lathe and planer tools and expanding mandrels at the Saratoga Convention. This company is foremost in the field of tool holders for the economical use of self-hardening steel, their holders having among other advantages the particular advantage of a support directly under the point of the cutter. Tool holders were exhibited of the straight and offset types, and for diamond-point, inside, cutting-off and threading cutters. Also a spring-threading holder, a special planer-tool holder, a boring-tool attachment and a set of expanding mandrels were shown. The expanding mandrel consists of a taper arbor and a flexible slotted sleeve fitting upon it, and is used by driving the taper arbor through the sleeve when the sleeve is within the hole in the work, and thus expanding same into contact.

In the patent case in which the Pressed Steel Car Company asked for an injunction restraining John M. Hansen, president of the Standard Steel Car Company, from disposing of six patents and applications for patents, Judge Buffington has handed down a decision which allows Mr. Hansen to make any assignment of these patents and applications which he chooses, subject to the final decision of the court.

The Illinois Central has 1,000 miles of telephone lines and is rapidly extending them. At the recent meeting of the Telegraph Superintendents the telephone seemed to have made important progress.

CORRESPONDENCE.

PROFESSIONAL SPIRIT IN RAILROAD SERVICE.

To the Editor:

I may venture to say that to the majority of the readers of the American Engineer who read Mr. Delano's article in the June number on "Professional Spirit in Railroad Service" Mr. Delano must seem somewhat of an idealist, and that if our railroad companies are to await the more thorough awakening and development of this spirit because of the reasons set forth by Mr. Delano they may wait "forever and a day."

Early in his article Mr. Delano quotes Ruskin's saying that "a man who devotes himself to art must do it for art's sake alone." This is doubtless a very high and noble sentiment, but the artist must live, and his desire is, like that of other mortals, "to live as well as he can." The professional requirement "that a man should enter into his work with heart and soul, and with the desire and intention of doing something worth doing," I think is now commonly prevalent among the "younger blood" of the railroad employees. But I maintain that the first thought behind all this is, and never can be anything else, than self advancement. The mere pleasure in the performance "of the thing worth doing" and consequent approval of the employer, are very large factors in the incentive, but human nature would not be human nature if the individual benefit to accrue was not uppermost in the mind of the doer. If railroad companies do not see fit to value and reward service as highly as do operators in the manufacturing field, surely the young man who has entered railroad service may be forgiven for "listening to the siren voice of those who seek to tempt him away." Business is business, and ability attained by study and experience is a marketable product, and open to the highest bidder of good standing.

The railroad field is a most attractive one, yet it would seem that the "professional spirit" could be better fostered by means more substantial than by an appeal to the sentiment. The manufacturer does not look for sentiment as an incentive to his employees to render valuable service. Why, then, should the railroad company? It seems to me that the only man who would be likely to accept Mr. Delano's views without qualification is the man who finds it entirely unnecessary "to work for his living."

There are many who quit railroad service for other reasons than the mere allurement of increased salary in other directions. I have in mind a young man, at one time in railroad service, who promised to be one of the brightest and most valuable in his profession. He was full of the "professional spirit." He came to his position well equipped and full of enthusiasm. He found things in the department of which he was given charge in a state of chaos. He worked hard and faithfully for over two years, obtained the respect, admiration, loyalty and liking of the entire corps of his subordinates, both sub-department heads and rank and file, and good results brimmed over. The management, however, at the end of this time failed to appreciate these good results, and the young man's resignation was voluntary. He retired to the manufacturing field, disgusted with railroad service. In the employ of one of the largest manufacturing concerns of this country, he is now, one year after leaving railroad service, in receipt of almost three times his salary as a railroad employee. This instance is but one of many, and is brought forward to show how blind the management of many railroad companies are to the real interests of the company, and if they would create and foster the "professional spirit" they must wake up to an appreciation of it. A. H. WESTON.

100 Broadway, New York.

An interesting and instructive exhibit of electric driving of machine tools, by the Bullock Electric Manufacturing Company, attracted interested attention at the Saratoga Conventions. The multiple voltage system of this company was shown as applied to a 28-in. Lodge & Shipley lathe by a motor mounted on top of the headstock, gear connected. This ran at 200 revolutions per minute and a speed range of the spindle of from 1 to 400 revolutions per minute in 26 steps was obtained by the multiple voltage system. The controller was mounted on the front of the base, below the headstock, and operated by a handle on the slide rest. Speeds intermediate between those obtained from the different voltages were secured by resistances. A motor-generator set and a single panel switchboard completed the installation.

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EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING PAGES. *The reading pages will contain only such matter as we consider of interest to our readers.*

Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

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Two very important papers were read at the recent convention of the American Institute of Electrical Engineers, held at Great Barrington, Mass., one regarding electric traction for the New York Central Railroad, by B. J. Arnold, and the other a joint paper relating to comparative acceleration tests of steam locomotives and electric cars, by B. J. Arnold and W. B. Potter. The first paper is an abstract of the report made by Mr. Arnold to the management of the New York Central, proposing plans for the electrical operation of the section of the road within the city. As a result of tests Mr. Arnold has recommended a combined electric system of third rail for the main line section of the road and overhead conductor construction for the yard (similar to the overhead system which the B. & O. R. R. recently discarded for the safety third rail system), and the entire system is to be operated by direct current, there not being sufficient time to make necessary tests upon possible alternating current systems. Mr. Arnold's calculations indicate the probability of a slightly lower cost of operation by electric than by steam locomotion, due consideration being had for the extra expenses and maintenance of the power station, transmission system, etc. The second paper, in determining data by short-haul tests, reveals the fact that the electric cars, owing to their more even starting torque, utilize to better advantage the weight on their drivers, and are able to maintain their accelerating rate much longer than steam locomotives. Another point was brought out, which is usually lost sight of, that the energy per seat mile, or per passenger mile, is much less with the electric car, on account of the seating capacity of the locomotive. Further reference to these important papers will be made in a later issue.

MASTER MECHANICS' CONVENTION.

The American Engineer Tests received an unexpected and pleasing indorsement in the address of President Waitt, which is referred to elsewhere. It is exceedingly gratifying to have this recognition. Later in the convention the resolution offered by Mr. Quereau again brought the tests before the association, and the Executive Committee was instructed to assist in the work. This action is thoroughly appreciated, and we thank the association for its endorsement. The investigation of the subject of stacks has progressed to the stage of analysis of the data and it is too early to plan for the next step, but the field is almost infinite. Thus far the entire expense has been borne by this journal, and the plan has worked well, but the character of the subject and the desirability of the active co-operation of the railroads will render assistance very acceptable in extending the investigation. We desire to again acknowledge the help of Mr. Vaughan, the Lake Shore Railroad, the Railroad Committee, and especially Professor Goss and Purdue University, for the efforts which have advanced the work to such a point as to justify the statement that the results will throw valuable light upon the designing of front ends. In a topical discussion referred to in another column, Professor Goss briefly stated the conclusions which are justified at present and the completion of the report promises to be as valuable as it is interesting.

The presidential address by Mr. A. M. Waitt should be read carefully by all officials who are in charge of subordinates. In dealing with motive power subjects he included the vital elements of organization and the principles of management involving the treatment of men. His expressions were not whispered, but clearly spoken. There can be no doubt that human nature is to be considered in the future operation of railroads as it has not been in the past. Mr. Waitt has set a difficult pace for future presidential addresses.

The association cannot have too many papers like that of Mr. Seley, describing the application of electric driving to a railroad shop. New shop problems are much simpler than those involved in refitting old plants. As many old shops are to be equipped, the questions discussed by Mr. Seley are exceedingly important. The present state of opinion and knowledge of electric driving and its rapid development and improvement render it necessary that the association should pursue the plan which is so well started.

Shop papers are specially appropriate just now, when so many roads are building or considering shops. Mr. Pomeroy suggested a plan for a new shop which might well have been a description of an actual plant. The discussion was disappointing, and the opportunity for a general exchange of opinions as to the arrangement of tracks was lost. This leads to a conclusion which is justified by the entire convention, namely, that the discussions throughout were of little value. Discussions should not be less valuable than the reports or papers themselves, but these did not in any case add much to the information of the members. This was evidently due to lack of preparation, which is explained by the delay in getting out the advance papers. It would be well to adopt a rule excluding papers from presentation unless they are ready for distribution at least a month before the convention. Carefully prepared discussion is absolutely essential to the life of the association.

A short time ago a building which would house locomotives, and a turntable, sufficed for a roundhouse. Now a roundhouse is but one part of a locomotive terminal, the efficiency of which largely governs the efficiency of the motive power department. This was made clear by the roundhouse report. This paper furnishes strong arguments for liberal treatment of this problem. A roundhouse plan necessarily involves a large appropriation, and nothing which can contribute to quick service in caring for locomotives should be omitted. Chief engineers

who were asked to contribute information to the committee had asked to have copies of the report sent to them, thus indicating interest in the requirements of the motive power departments.

Mr. Whyte's paper on water service is the best record of this equipment that has appeared. It covered practically the whole field of water service, and the treatment of water scoops and track tanks is specially valuable. It is a good plan to include record papers in the proceedings, in order that these volumes may reflect progress in a form convenient for record. This paper will stand for the present state of the art.

It was noticeable that a number of large roads had no representatives at the conventions. Others had several. One road sent two draftsmen and seven other representatives. Presumably this road will profit by this liberality. The discussions in the meetings themselves form but a small part of the value of the conventions. Much is to be gained by the extension of acquaintance and the exchange of opinions as well as in studying the exhibits. Why is it not a good plan for each road to send a representative and require him to report the conventions to the management?

The exhibits this year were specially interesting, machine tools being more prominent than in previous years. These received a great deal of interested attention, indicating a marked interest in the subject among the members.

MASTER CAR BUILDERS' CONVENTION.

The convention is generally considered one of the most successful ever held by the association. Perfect weather, good attendance and worthy subjects combined to produce good work and healthy progress was indicated.

The standard car was advanced by an important step, though a final decision as to standard exterior dimensions was not reached. It will not be surprising if the constructive dimensions should occupy the attention of this association for a year or two, in view of the fact that it has taken ten years or so to obtain standard interior dimensions. The M. C. B. Association undoubtedly will soon come to appreciate that this movement has been prepared for them and that they are expected to finish this important work. When they realize this the adoption of standards will probably proceed along the lines of the other work for which this association has made so high a name.

As usual, the topical discussions stimulated the thought of the members and brought many of them to their feet who would respond more slowly in the other discussions. The experience of the last few years indicated the value of these informal discussions as a method of assisting in the selection of subjects for formal reports for the coming year. The topical subjects this year were specially well selected, carefully presented and ably discussed.

The draft gear report furnished another example of the great importance of securing actual service conditions in comparisons between various devices or constructions used in cars. Tests of draft gear must be made on cars or under car conditions in order to secure the information wanted. A drop test gives high velocity to a relatively small weight and not a low velocity to a great weight, as occurs in service operation of trains. A candle may be fired from a rifle through a board because it has no time to flatten out under such a high velocity. Drop tests may bring out comparisons of strength of material, but they will not show the best draft gear, because they do not give the resistances time to act as they are intended to act. Furthermore, the recoil cannot be measured under a drop weight, because a 1,640-lb. weight will rebound more than a 135,000-lb. car. The drop test really obscures, or at least entirely changes, the action of the preliminary spring of a friction gear.

Steel cars have had a remarkable infancy. The discussion revealed the fact that in 1897 the Schoen Pressed Steel Car Company, the principal builders of steel cars, turned out 501 cars. In 1898 they built 2,931; in 1899, 9,624; in 1900, 16,671, and in 1901, 24,590. The total number of steel cars built by this company and its successor, the Pressed Steel Car Company, up to June, 1902, was 63,872 cars, and the total number, including those of other builders, is about 70,000. Thus far, however, this association has not given its official opinion with reference to methods of construction. At this convention it was suggested that a committee take up the design of 80,000 and 100,000-lb. cars and metal underframing for gondola, box and flat cars.

An interesting discussion, introduced by Mr. Sanderson, upon the advisability of using metal center sills in wooden car construction, developed strong opinions on two principles in car construction. The first is that steel and wood cannot be combined in the same structure without danger of failure, because of the difference in deflection of the members of each material, and because of deterioration resulting from moisture between the surfaces of metal and wood. The old time flitch plate, or sandwich, bolster was an example of failure cited to support this opinion. It was held that if steel is used in connection with wood the steel should be placed under the wood and under the frame, as in the case of draft sills. The second principle concerns the necessity for increased strength to meet the enormous buffing strains of present conditions. Speakers with the most extensive experience with steel cars maintained that the time had come to use all steel underframes, because they are needed on a score of strength. In other words, in their opinion, the time for wooden underframes has passed.

Improvements in cast iron wheels, both in material and design, have apparently led to the conclusion that this wheel, which has contributed so extensively to the success and progress of railroads in this country, is worthy of confidence.

With the increasing capacity of cars and the weights of cars and loads it has been long apparent that a device is needed which would make it possible to adjust the braking power so that it will not be the same for a car when empty and loaded. A topical discussion revealed the fact that the Burlington & Missouri River Railroad is now experimenting with a new triple valve which by a hand adjustment changed the braking power. Seven of these were tried and 30 more are to be put into service. More experience is required before a report can be made as to its value, but it seems promising. Other ways have been devised to accomplish the same object, for example, the application of two cylinders of different diameters, with a cock to control them. Years ago devices were suggested for the automatic control of the braking power, making the braking power a function of the load. It is apparent that this is to be a question for development in the near future. Some special provision must soon be made to improve methods of handling large capacity cars, fully loaded, when descending heavy mountain grades. There seems to be no objection to devices, such as cocks, which may be manipulated by trainmen, whereby empty cars may be given the usual precentage, and fully loaded cars may be given an increase of brake power. It will probably not be advisable to provide any intermediate adjustment from an empty to a loaded car, because of the additional complications involved.

Mr. G. W. Rhodes always brings up some important question at these conventions, and it is usually a reminder of some principle which has escaped attention of less observing and studious men. This time he presented a brief discussion entitled "Meters for Stopping Leaks in Car Work Expenses." This is referred to elsewhere in this issue, and his remarks will be printed in full next month. One effect was to lead several speakers to compare the cost of work in contract and railroad shops. Members were not quiet under the charge of securing but one-fourth of the full capacity of their shop machinery, and rose to defend themselves. Without doubt excellent progress has been made in recent years in the effort to put railroad shops upon the contract shop, or commercial,

basis. This is, in fact, one of the promising movements of the time. While such defense will look well in the proceedings of this convention, the fact remains that railroad shops are woefully behind the commercial shops, not only in their use of their machinery, but in their methods of operating it. It is idle to argue that railroads are now doing their shop work as cheaply as it is done by commercial plants. There may be exceptions in cases of roads with special equipment for building cars, but railroads should not deceive themselves as to the facts regarding their shop work as a whole. This journal will soon undertake to treat this subject systematically, for there is no doubt that the commercializing of railroad shop practice offers not only an opportunity for progressive mechanical men, but it is positively necessary that greater progress should be made in this direction.

Purdue University already is custodian of the air brake testing rack of the M. C. B. Association, also the brake shoe testing machine. It was decided at this convention to add a new drop testing machine for testing couplers and axles to this equipment, by agreement with the University. The machine will be constructed, probably, at the expense of the association, the University to provide the foundation, maintenance and insurance. This will bring all of the testing equipment of the association together in one place, where it will be permanently cared for and where assistance and observers are always available for experimental work. The school is to be congratulated upon its policy of securing this equipment, which ties it closely to progress in railroad work, and the association is equally fortunate in having its apparatus in such competent and responsible hands.

Among the exhibits this year draft gears were more prominent and numerous than ever before. This seems significant of the tendency toward improvement in this direction.

The convenience of the fuel-oil flue-welding furnace of the Railway Materials Company of Chicago was demonstrated at the recent conventions at Saratoga. This company exhibited a furnace in operation, the blast being furnished by a motor-driven blower. With one of these furnaces a temperature for welding is obtained for 10 hours on a consumption of 25 gals. of oil. The capacity of the furnace is limited only by the ability of the man handling the flues. A fair continuous rate is 65 2-in. flues welded per hour, and 100 may be done if necessary. One hundred 2-in. flues are scarfed and put together ready for welding in an hour, and the same number of safe ends in 15 minutes. Three hundred and forty-six flues have been put through the shops in six hours by one man and a helper. This furnace has been introduced on 40 railroads in one year.

A compact 40-foot air-compressor, belt-driven by a 7-h.p. Foos gasoline engine, was exhibited at the Saratoga Convention by the Rand Drill Company. The compressor is their "Imperial No. 11," with 6 by 6-in. cylinders, and the ratio of speed is 310 revolutions of the engine to 200 of the compressor. The exhibit also included a similar compressor belted to a 7.5-h.p. motor, a compound 360-foot "Type 10" compressor, with 9 by 12-in. steam and 9 and 14 by 12-in. air cylinders, and an 8 by 8-in. "Imperial" belt-driven compressor.

The Kindl Car Truck Company, of Chicago, exhibited models of Kindl and Cloud trucks at the Saratoga Conventions, and a great deal of attention was given to the Kindl truck with rollers for side motion. It is becoming evident that side motion is desired by those who are anxious about the failure of cast-iron wheels. This company has recently acquired the Cloud truck, and is now prepared to supply it in either the plate or trussed form.

The Soule Dust Guard Company, 113 Devonshire street, Boston, exhibited their rawhide-lined dust guards at the Saratoga Convention. This guard is made of wood and is lined with a narrow ring of rawhide secured in a recess on one side. The construction is such as to bring the wear upon the rawhide lining.

SPRING MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

The forty-fifth meeting of the American Society of Mechanical Engineers was held in Boston, Mass., from May 27 to May 30, opening with a Tuesday evening meeting in Huntington Hall in the Rogers Building of the Massachusetts Institute of Technology, and closing with the Friday morning meeting in Pierce Hall at Harvard University. It was one of the best attended conventions ever held by the society, over 800 members and guests being in attendance.

The opening meeting consisted of an address of welcome by President Pritchett, of the Institute of Technology, followed by an address by President Kimball, of the Boston Society of Civil Engineers, which were responded to by Senior Vice-President Dodge, in the absence of President Reynolds. Under the head of new business, Mr. Fred J. Miller offered a resolution providing a letter ballot of the members upon proposed amendments to the rules, which was accepted to be voted upon, under the rules, at the fall meeting at New York. Mr. Henry R. Towne then presented a resolution calling for the appointment by the acting president of a nominating committee to nominate a committee to revise the rules, etc., and report to the society in time for the result to be mailed to the members before the next annual meeting, which was also agreed to.

The important matter of the proposed increase of membership dues then came up for consideration. As will be remembered from our account of the last December meeting, in our January issue, there was great surprise when it was learned that the society was over $13,000 in debt, and as a result of which the council of the society instigated a thorough investigation of the financial affairs, instead of favoring the increase of dues. A few weeks before the late meeting a 24-page pamphlet report of the investigations of the council was distributed to the members, giving in considerable detail the financial status of the society, with recommendations for the future, which may be summed up as follows: An investigation of the society's accounts by an expert accountant revealed them to be correct, showing that at the close of the last fiscal year the society had a floating debt of over $15,000, and that during that year the income had exceeded the expenditures by only about $200. It was also revealed that in the 22 years of the society's existence there had been accumulated a surplus of over $73,000, but that at present there is no surplus at all to meet an emergency and no means whatever of reducing the mortgage of $33,000, which still remains on the society's house and library. Certain unimportant economies were recommended and inaugurated by the council, but for a conclusion of the report the council again advocated an increase of dues, but this time to $20 per year.

In consideration of this report Mr. Fred J. Miller, of the finance committee, presented a careful statement respecting the present condition of the society, which, judging from the hearty applause with which it was received, expressed the sentiment of a large majority of the members present. He called attention to the fact that there had been accumulated during the past 22 years a surplus of over $73,000, which if accumulated uniformly in that time would mean an annual saving of about $3,300. That entire surplus has now disappeared, and, as it is replaced by a large deficit, it is wise to consider the reasons for it and whether the increased expenditure is wise or necessary. In regard to the character of the published volumes and the quality of the papers printed by the society and the improvement of them, he was of the opinion that, while an improvement in the practical usefulness of the papers presented is very desirable, it is doubtful if such improvement can be secured by mere expenditure of money alone, and suggested that possibly different methods might bring about such an improvement. He took exception to the final conclusions of the council that it would be advisable to raise the dues, stating that there is a prevalent and perhaps growing conviction among the members that the society will never be able to do all that it should do, nor to develop the degree of usefulness which it should, or might, develop, until it has a secretary who is not only efficient and business-like, but who can devote his entire time to the affairs of the society, having no other interests which he may consider paramount. With the cost of operation of the society's house of over $3,700 per annum, he considers the maintenance of this house an expensive luxury, especially when the interest actually paid out on the mortgage indebtedness upon it is considered in addition to the figure just mentioned; while admitting that the advantages of the society's owning its own house are of great weight, still he questions if these ad-

vantages are not being very dearly paid for, especially when it is considered that the house has become totally inadequate for its chief purpose. Mr. Jesse M. Smith thought there should be no curtailing of expenses that would in any way interfere with the usefulness of the society. He favored a free distribution of the papers, in advance of the meetings, to all members of the society, as had been done previously, until withdrawn as a measure of economy. Mr. Harrison Emerson thought organizing talent, so important for engineers to possess, to be very poorly represented by the management of the society, and that it was, in his opinion, after considerable study on the matter, possible to effect an economy of at least $10,000 per year without in any way interfering with the efficiency and usefulness of the society. He thought considerable saving might be effected in the printing, and stated that 25 per cent. of the society's income was entirely too large a proportion to be expended in salaries.

The paper on "Electricity in Cotton Mills" is one from which much may be learned with reference to the electric driving of machine tools in machine shops, as well as the question of the central power station for generating the current; much valuable information was presented with reference to the alternating current drive from the standpoint of efficiency. Professor Benjamin referred to some tests that he had made, in which it was proved that there was nothing to be gained in efficiency over the shafting method of distribution, while Mr. S. M. Vauclain stated that the introduction of electric driving in the Baldwin Locomotive Works had resulted in an economy of floor space amounting to 40 per cent., simply because the machinery could be placed to the best advantage without regard to means of receiving power.

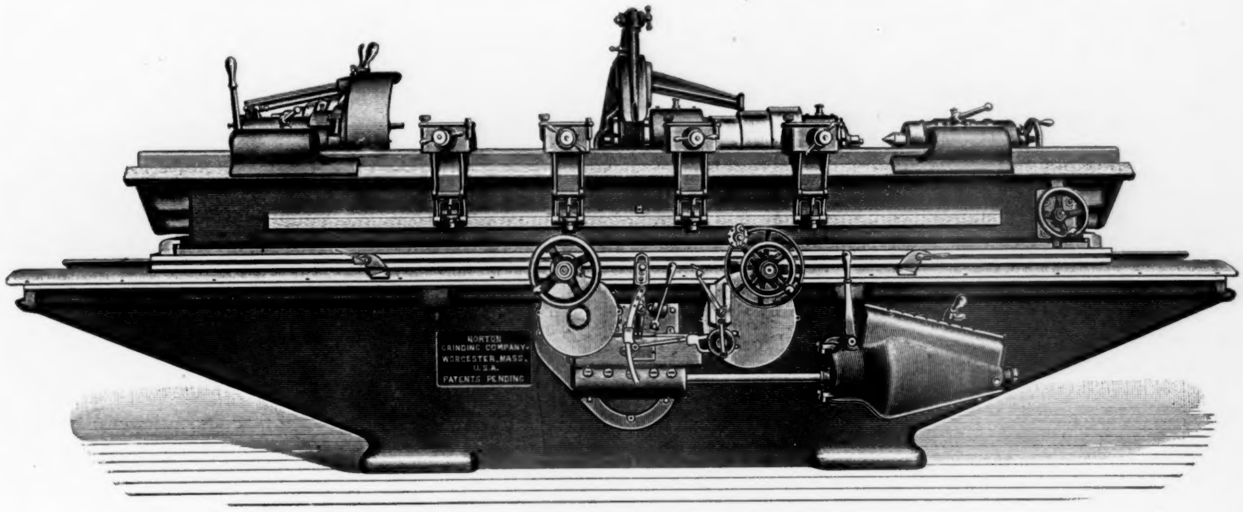
This meeting was one of the best attended and in some ways the most remarkable convention ever held by the society, but it is to be regretted that in general the value of the papers presented was not in keeping. The large attendance was no doubt due to the many attractions in Boston and vicinity, which were greatly enjoyed by the members on the several excursions tendered them. The notable feature of this convention seems, however, to be the "housecleaning" which has been begun, and which will be continued, as a result of the investigation of the society's financial affairs and management; it seems to be the general opinion of the members that the usefulness of the society can only be increased when work is done and conditions secured which money cannot buy, and that in consequence the expenses should be lightened rather than increased.

It is to be regretted that none of the papers presented at this meeting are of sufficient interest to our readers to warrant their publication in full in our columns. We can only feel that this is the result of a lack of appreciation of the importance of the many problems still to be solved in the transportation field. Much valuable work can be done by the society in connection with the many purely mechanical problems in both steam railway practice and interurban electric railway practice, and this not by an increase of membership dues, but by an arousal of interest among both officers and members.

NORTON HEAVY GRINDING MACHINE.

The demand for the Norton grinding machine has steadily increased since it was brought out, only a short time ago, and it has become an established standard in a majority of the large shops. The accompanying illustration is a view of the 18 by 96-in. heavy plain grinder. As may be seen, all adjustments are controlled from the front side, there being sixteen changes of table speed, eight changes of work speed and six changes of wheel speed, all independent of each other. Among the features of this machine is the extra heavy swivel table of triangular section, with a peculiar arrangement of ways for the head and foot stocks, which gives especial stability.

It has long since been demonstrated that grinding is an economy, and not an expense; this machine has demonstrated its ability to do the accurate sizing of cylindrical work, in place of the "finishing" or "sizing" cut usually made with the lathe. Its massive proportions enable it to remove stock in large quantities, so as to allow of very crude turning in the lathe. This very materially reduces the cost of the lathe work and gives round and smooth work at a total cost much less than by the old lathe and file method. For example: A Rice & Sargeant engine exhaust valve 26½ ins. long by 5½ ins. in diameter was turned and ground complete to limit of 0.002 in. in 42 minutes. Another valve, 12 ins. in diameter by 60 ins. long, weighing 827 lbs., was ground to a limit of 0.002 in., removing 0.025 in. from the diameter, in 1 hour 15 minutes. Crucible steel lathe spindles 50 ins. long, with nine diameters, the largest bearing being 5¼ ins., were rough turned from the forgings and ground to a 0.005-in. limit complete, ready to use, in five hours.



Norton Heavy Grinding Machine.

A locomotive piston rod in repair work may be ground in 30 minutes, and the material which would be cut away by a lathe-tool may be saved, and the rod is left perfectly round and smooth. This work is known to take two hours in many railroad shops with the usual methods. In finishing new piston rods a single roughing cut is taken, leaving 1-32 in. for grinding. Car axles constitute a large field on railroads for grinding, and several up-to-date roads are preparing to grind all their axles. We shall take this subject up systematically in the near future.

The Norton Grinding Company, Worcester, Mass., are building a new machine shop at Barbers Crossing, where their heavy plain grinding machines will in the future be manufactured, instead of at the shops of the Norton Emery Wheel Company, as heretofore. The new shop is located near the plant of the Norton Emery Wheel Company, and will have all modern conveniences, including an electric traveling crane capable of handling the heaviest work in the shop.

The "Twentieth Century" trains, which went into service on the New York Central and Lake Shore Railroads on June 15, 1902, making the run of 980 miles between New York and Chicago in twenty hours, are equipped with the "Axle Light" system of electric lights and fans of the Consolidated Railway Electric Lighting and Equipment Company, 100 Broadway, New York.

THE GOLD CAR HEATING & LIGHTING COMPANY.

The Gold Car Heating & Lighting Company, which has just been incorporated under the laws of the State of New York, with a capital of one million dollars ($1,000,000), has purchased outright the entire business of the Gold Car Heating Company, of New York, Chicago and London, and also the entire business of the Gold Street Car Heating Company.

It takes possession on July 1, 1902, of all of the property of both of these companies, and in addition to nearly 100 patents already owned by them, has acquired a number of new and valuable patents covering electrical apparatus.

The business of the Gold companies has increased enormously during the past five years, and now extends all over the world, wherever railway cars are operated by steam or electricity.

The Gold companies have a larger number of unfilled contracts on their books just now than ever before in the history of their business. At the present time they are engaged in equipping new cars or locomotives being built for the following railroads:

New York Central, Lake Shore & Michigan Southern, Jersey Central, Delaware, Lackawanna & Western, Lehigh Valley, Norfolk & Western, Philadelphia & Reading, New York, Ontario & Western, Chesapeake & Ohio, Southern, Atlantic Coast Line, Plant System, Alabama Great Southern, Waycross Air Line, Cincinnati Southern, Nashville, Chattanooga & St. Louis, Louisville & Nashville, Northern Pacific, Minneapolis, St. Paul & Sault Ste. Marie, Chicago, Burlington & Quincy, Missouri Pacific, Texas & Pacific, Denver & Rio Grande, Union Pacific, New Orleans & Northeastern, Pittsburgh & Lake Erie and others.

The foreign business of the company is larger now than ever before, over 2,000 sets of car-heating apparatus being under construction for shipment abroad within the next three months. Among the large electric heater contracts recently received is one from the Louisville Railway Company for over 300 sets of car-heating apparatus, and orders from the Jersey street railways for about 100 equipments, as well as from the Boston & Maine, New York, New Haven & Hartford, Massachusetts Electric Companies and South Side Elevated Railroad of Chicago. A contract has recently been closed with the Metropolitan Street Railway of New York for electric heating apparatus which will be a departure from anything of this character heretofore undertaken.

In addition to all of the work now under way, the Gold companies have already equipped nearly 40,000 cars and locomotives on about 500 railroads all over the world. The capital of the Gold Car Heating & Lighting Company, which takes over all of this business, is $1,000,000, and has been more than fully paid. There are no bonds on the new company, and there is no preferred stock. Its capital is represented by 10,000 shares of common stock of the par value of $100 each, fully paid and non-assessable, and the company has no other liabilities whatever. The net value of the property taken over by the new company is $1,090,000.

Mr. Edward E. Gold, of New York City, has been elected president of the new company, and made chairman of the executive committee. All of the stockholders of the old companies will be numbered among the stockholders of the new company, the plan having received the unanimous approval and consent of every shareholder in all of the properties purchased. The main office of the new company will be at Frankfort and Cliff streets, New York City.

The new 20-hour trains of the Pennsylvania and New York Central systems between New York and Chicago have been successfully inaugurated. The shortening of the time makes it possible for a busy man to save almost a complete business day in this journey, for 5 hours are practically a day in these times of business stress. The schedules are as follows:

New York Central—Leave New York, 2.45 P. M., Eastern time; arrive Chicago (by the Lake Shore), 9.45 A. M., Central time; returning, leave Chicago, 12.30 P. M.; arrive New York, 9.30 A. M.

Pennsylvania—Leave New York (Twenty-third street), 1.55 P. M.; Philadelphia, 4 P. M.; Harrisburg, 6.05; Altoona, 8.45, Pittsburgh, 11.20; Chicago, 8.55 A. M.; eastbound, leave Chicago at noon; arrive at New York, 9 A. M.

There has been no difficulty in making the time, and for long distance service these trains lead the world. If present expectations are realized this service will be permanent.

BOOKS AND PAMPHLETS.

The J. G. Brill Co., Philadelphia, Pa., have recently issued a very attractive descriptive pamphlet and folder regarding the Brill No. 27 perfectly equalized steam and electric passenger truck. In its latest form this truck is built up with solid forged side frames, which insures the maximum rigidity and squareness, and its characteristic features of three sets of springs supporting in series between the frame and the truck bolster and the link spring-suspended equalizing bars provide a perfectly equalized and cushioned bearing of the load. This truck is claimed not to cant or tilt under brake action, and on account of its very wide link suspension base to carry the car more steadily around curves than the usual standard truck. These and its other advantages render it adaptable to steam railroads, as well as to elevated and electric roads. The catalogue is illustrated with engravings showing the truck and its details, together with two views of its application to elevated road and to electric road practice.

A very artistic little booklet was gotten out by the Niles-Bement-Pond Company, New York, for distribution at the Crystal Palace Exposition in England. It comprises a series of engravings illustrating representative tools of their production, including heavy engine lathes, both standard and motor-driven, planers, slotters, boring mills, etc., and special railroad tools, such as special driving-wheel and car-wheel lathes, axle lathes, car-wheel boring machines and wheel presses.

Also a beautifully illustrated new steam-hammer catalogue was recently issued by the Bement, Miles & Co. branch of this company, in which the various types of hammers built by that branch are illustrated and described. It includes single-frame, double-frame, open-frame and double-frame steel tilting hammers, and drop hammers of both the belt-driven and steam types. The hammers are described as to rating, valve and valve-gear, testing, etc., with instructions for erecting. It is to be noted that this company rates their steam hammers according to the actual weights of the falling parts; thus, a 1,100-lb. hammer means one whose ram, piston and top die, together, weigh 1,100 lbs.

A beautifully illustrated brochure, entitled "A Colorado Summer," has recently been issued by the passenger department of the Santa Fe, illustrating and describing the principal resorts on their entire system, including the Colorado Midland, the Denver & Rio Grande and the Colorado & Southern. It is very artistically gotten up, and enticingly describes the many pleasures of the Colorado region and the West.

An interesting folder has been received from the Soule Rawhide-Lined Dust Guard Company, Boston, Mass., in which the necessity of care and protection of journal boxes from dust and grit is set forth. It is stated that as many as 50,000 of their dust guards are ordered per annum by individual railroads for repair shops.

The "Major" Coupler is illustrated and described in a pamphlet received from the Buckeye Malleable Iron & Coupler Company, Columbus, Ohio. The reputation and high standing of this company would justify attention to any announcement they may make, but when they issue a description of a coupler designed to secure the advantage of the full capacity of the M. C. B. coupler shank our readers are urged to give it the attention it deserves. Ten minutes suffices to read this pamphlet and learn how the new coupler is made to secure a positive lock set in the head, a knuckle opener, a construction which relieves the knuckle pin of stress and gives large bearing areas and wearing surfaces, provides deep sections of metal where strength is needed and without adding to the number of parts of the old-time M. C. B. type couplers. The pamphlet is well printed and well illustrated. It represents the result of experience, combined with a desire to meet the conditions of increasing severity in the handling of cars.

A profusely illustrated catalogue has been received descriptive of the Century belt conveyors and conveying machinery, manufactured by the Jeffrey Manufacturing Company, Columbus, O., in which different types of apparatus are shown for conveying all manner of material, from ores, sand, refuse, gravel, coal, ashes, etc., to packages, rolls of cloth, bags of grain, etc. The endless belt conveyors are made to run flat, or troughing to carry material combined with liquids. Also bucket conveyors, endless wooden apron and pan conveyors, are shown, together with crushers and sizing screens for coal, rock and other materials.

FEED-WATER HEATER FOR LOCOMOTIVES.

By M. N. Forney.*

To convert one pound of water of zero temperature into steam at 200 lbs. pressure requires 1,231.7 units of heat; a unit being the amount required to raise 1 lb. of water 1 deg. If the average temperature of water in a locomotive tender is 60 deg., then 1,231.7—60 = 1,171.7 units of heat must be imparted to it to convert it into steam of the pressure named. One per cent. of that will be 11.71 units, so that if each pound of feed water is increased that many—or, say 12—deg. in temperature, by waste heat, before it enters the boiler, it will be equivalent to a saving of 1 per cent. of the fuel required to convert it into steam. This is true theoretically, and has often been proved practically.

Assuming the average pressure of the exhaust steam to be 10 lbs., its temperature will be 240 deg. If it and the feed water are brought into such relations to each other that the heat of the steam can be communicated to the water, the latter will be heated up to

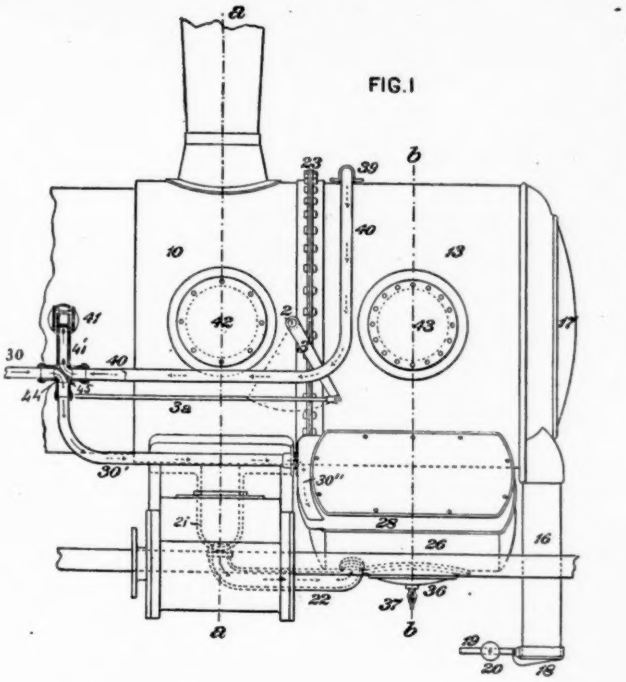


FIG. 1

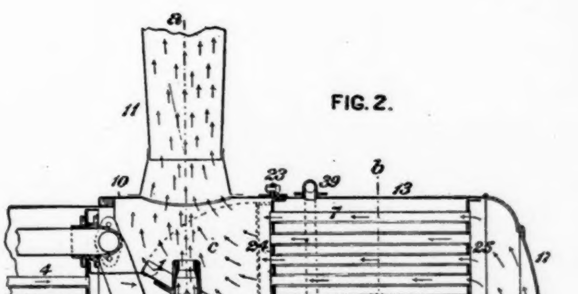


FIG. 2.

the temperature of the steam. What is required to do this in a heater is plenty of time and sufficient heating surface. If, then, the feed water is thus raised from a temperature of 60 deg. to 240 deg.—or increased 180 deg.—it would result in a saving of 15 per cent. of heat, and consequently of that proportion of fuel.

*501 Fifth avenue, New York.

But the temperature of the waste gases in the smoke-box of a locomotive when it is working steam varies from about 400 deg. to 1,200 deg. If we heat the feed water first by the exhaust steam and next by the waste gases, then, if the feed water is raised to 300 deg. or increased 240 deg. in temperature, the saving would be 20 per cent.; if to 360 deg., 25 per cent., and to 420 deg., 30 per cent. Of course, if the water was heated to the latter temperature, in a separate heater, part of it would be changed into steam before it entered the boiler, because the sensible temperature of steam of 200 lbs. pressure is only 388 deg.

Fig. 1 represents a side view and Fig. 2 a longitudinal section of the front end of a locomotive boiler and smoke-box, with an exhaust and fire-heater; 13 is the fire-heater, which is bolted to the front end of the smoke-box by angle-iron flanges 23, and 26 is the exhaust-heater, located below the fire-heater. Fig. 3 shows two vertical half-transverse sections, the right-hand half taken on the line *a a* of Figs. 1 and 2, looking forward, and the left-hand half on the line *b b*, looking in the same direction.

The exhaust-heater, 26, consists of a crescent-shaped vessel made to conform to the contour of the cylindrical fire-heater, 13, above it. The outside shells of both are made of boiler plates, excepting the ends, 28 28′ of the exhaust heater, which consist of cellular castings having double plates with water spaces between them. It is provided with a series of bent tubes, 27 27′ 27″, Fig. 3, which are connected to the inner plates of its heads. The spaces between the plates are divided by partitions, one of which, 32, is shown to the left side of Fig. 3, and another, 32′, is represented by the serpentine lines in Fig. 5, which is a half-sectional view of one of the heads of the heater, drawn on the line *c f* of Fig. 3 and looking in the direction of the dart *d*.

The tubes are bent to correspond to the form of the heater and to permit them to be expanded and contracted by changes of temperature.

The feed water is conducted from the pump or injector to this heater by the pipe 30, shown in Fig. 1, and also on the right side of Fig. 3 and in Fig. 5. The direction of the flow of water is indi-

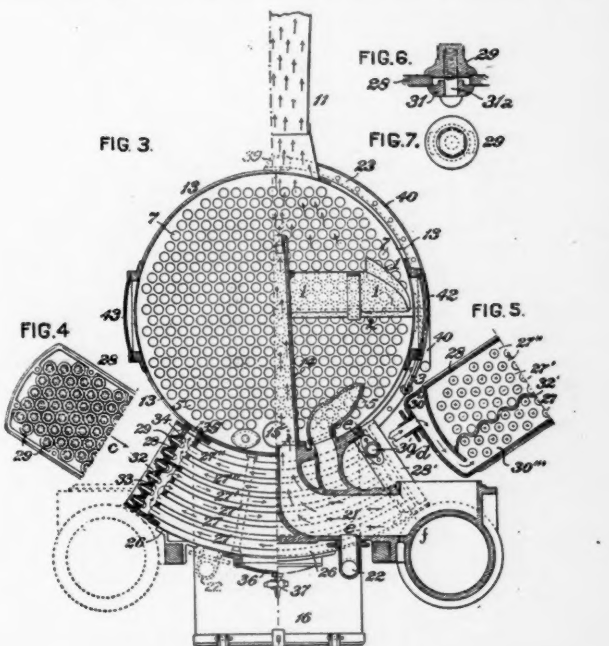


FIG. 3. FIG. 4. FIG. 5. FIG. 6. FIG. 7.

cated by the arrows in the pipe 30 and 30′, Figs. 1 and 5. From the latter figure it will be seen that the water passes from the pipe 30′ to the chamber 30″ and downward to 30‴ and thence into the tubes 27. In order to indicate in the end view of the tubes, in Fig. 5, the direction of the flow of the water an × mark is used to show that the flow is from the observer and a — mark that it is toward him. From the two figures last referred to it will be understood that the water enters the lower series of tubes 27 27—which are represented by dotted lines on the right side of Fig. 3—and flows through them to the chamber 33, on the left, as indicated by the arrows. There the current is reversed and flows back toward the right, through the tubes 27′ 27′, to a chamber at the right-hand and adjacent to 28′, where the current is again reversed and the water flows back through the tubes 27″ 27″ to the chamber 34, from which it is conducted to the fire-heater 13 above by the passage 35.

Exhaust steam is conducted from the exhaust pipes 21, of the cylinders, to the exhaust heater by two pipes, 22 22, shown in Figs. 1, 2 and 3. The bent heating tubes, 27, 27′ and 27″ are thus surrounded and exposed to exhaust steam while the engine is working. The heating tubes being exposed to this steam, some of its heat is transmitted to the water inside of them. As the water must flow to and fro through them three times, it is exposed for a considerable time to the heat of the exhaust steam by which they are surrounded.

The exhaust-heater represented in the engraving has 88 tubes 2 ins. in diameter, and their average length is 50 ins., so that they have nearly 200 square feet of heating surface.

It is a well-known fact that the effect of heating many kinds of

water is to cause it to deposit its impurities as soon as it gets hot. With such water the result would be that the heating tubes would soon become filled with solid deposit unless they were periodically cleaned. To facilitate this, each of the tubes of the exhaust-heater has a hand hole and cover, 29, Figs. 3 and 4*, opposite to its end. One of these is shown on an enlarged scale in Figs. 6 and 7. By unscrewing these covers, access may be had to each tube from the outside of the locomotive, and they may be cleaned from end to end by using a flexible scraper, or any tube may be caulked or removed through the hand-hole opposite its end and a new tube put in its place.

The fire-heater 13, shown in Figs. 1 and 3, consists of two series of heating-tubes, 5 5 and 7 7, Fig. 2, inclosed in a cylindrical shell which is attached to the front of the smoke-box. This shell has suitable heads, 24 and 25, to which the heating-tubes 5 5 and 7 7

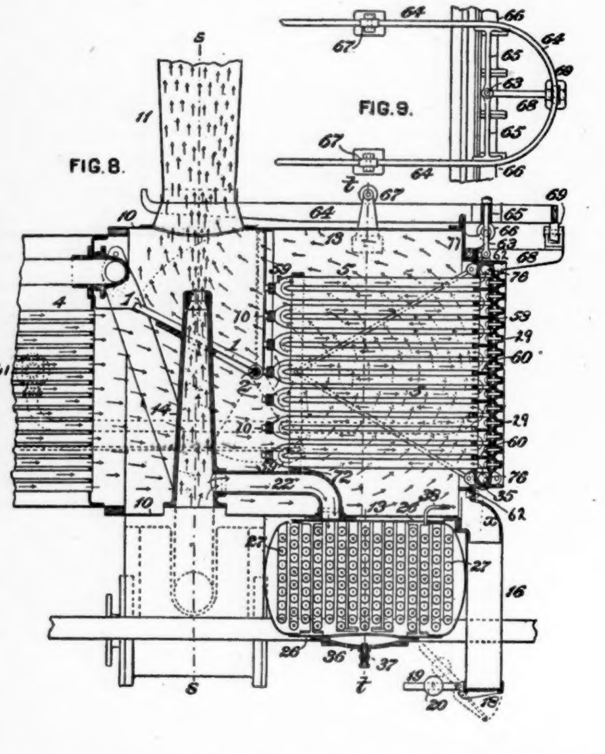


FIG. 8. FIG. 9.

are connected, and it contains the water to be heated, which surrounds the tubes. The waste gases from the boiler before they escape out of the chimney are caused to circulate through these heater-tubes by means of a partition or diaphragm in the smoke-box, provided with a door or valve, 1 1, by which the lower portion of the smoke-box may be separated from the upper part *c* and—as indicated by the arrows—the products of combustion are thereby conducted from the boiler tubes 4 4 through the lower portion of the smoke-box to the lower tubes 5 5 of the heater, and through them to a chamber, 6, in front of it, and then back through the upper tubes, 7 7, to the top chamber *c* of the smoke-box and thence to the chimney 11. The door 1 1 is attached to a transverse shaft, 2, which can be turned by a lever, 3, Figs. 1 and 2, on the outside of the smoke-box, and a rod, 3a, which connects the lever with the cab, thus raising the door into the position represented by the dotted lines at 24 in Fig. 2. Communication is thus opened from the lower chamber of the smoke-box to the upper one, and the chimney, so that the smoke and waste gases can then pass directly from the boiler tubes 4 4 to the smoke-box and out of the chimney.

The heater represented has 412 2¼-in. tubes 3 ft. 8 ins. long, and has 890 sq. ft. of heating surface. The temperatures in the smoke-box, when a locomotive is working under steam, vary from about 400 to 1,200 deg. With that amount of heating surface and such temperatures, a very large amount of heat would doubtless be transmitted to the feed water—how much cannot, of course, be determined, excepting by actual test, but, as already pointed out, these figures indicate not only the possibility, but the probability, of a saving of a very large percentage of fuel, and, in places where bad water is used, a very material saving in the cost of boiler repairs, by arresting the solid constituents of the water and depositing them in the heaters, and thus excluding them from the boiler.

When a feed-water heater is used the consumption of steam by an injector is a matter of much importance. It is a fact established by careful experiments that with a steam pressure of 200 lbs. it takes about 10 per cent. of all the steam generated by a boiler to operate the injector; or, in other words, it takes 1 lb. of steam to put 10 lbs. of water into a boiler. It is true that a considerable quantity of the heat of this steam is imparted to the water and is returned to the boiler, so that it is not wasted, but a pump operated by steam working expansively will require only about one-tenth or one-twelfth as much steam as an injector to force a given quantity of water into a boiler. The pump, however, will not heat the water, but if a boiler is fed with a pump and the feed water is heated by exhaust steam or the waste gases, then clearly there is a saving of about 9 per cent. of all the steam generated, because the pump takes only about one-tenth as much steam to work it as an injector does, and if the feed water from the pump is heated it may be delivered into the boiler at the same temperature as it is by an injector.

To get the full advantage of heating feed water, it is, therefore, essential to feed with a pump, and not with an injector, excepting when the engine is standing still or in emergencies. It is, therefore, proposed, in using the feed-water heater here described, to feed the boiler in regular service with a pump having a variable stroke, so that the quantity of water fed can be accurately regulated to the amount of work done.

The centers of the tubes are placed directly opposite those of the boiler tubes 4, and in order to make it possible to remove any of the latter without disturbance to the heater, the heater tubes are made of sufficient internal diameter so that the boiler tubes will pass through them, and the latter can thus be removed through the former and new ones substituted.

By the construction herein described a large amount of heating surface is provided in the fire-heater. The water is then admitted to or near its lower portion, and escapes through the nozzle 39 at its top and is conducted by a pipe, 40, to the check-valve 41, Figs. 1 and 2, and thence to the boiler. The fire-heater is, therefore, entirely filled with water, which is in contact with its heating surfaces for a period of time equal to that required for the consumption of a volume of water in the boiler equal to the contents of the heater.

No netting is shown in the smoke-box, but should it be needed it could be placed in the supplementary smoke-box, 6, as indicated at *g h*, and also below the door 1 1 in the smoke-box.

To provide for the contingency of the failure of the heater by the bursting or collapse of a tube or pipe, or other cause, and to prevent the engine from being disabled thereby, the feed pipes are connected to a four-way valve or cock, 44, Fig. 1. The feed pipe 30 is connected with the pump or injector; 30′ is a continuation of the feed pipe, and is connected to the exhaust-heater; 40 is a delivery pipe, and connects the fire-heater with the valve 44, and 41′ connects it with the check valve 41. The valve 44 is provided with a plug, 45,

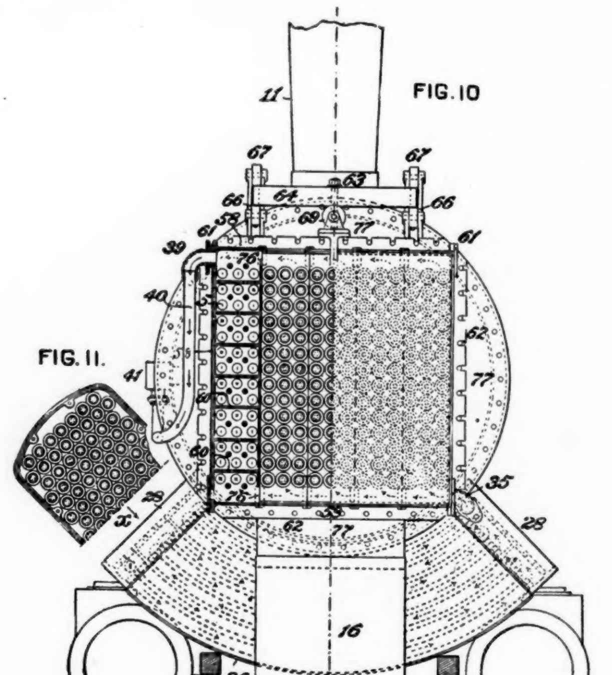


FIG. 10. FIG. 11.

which, when the heater is in condition to work, is set in the position in which it is represented. The feed-water can then flow, as indicated by the arrows, from the pump or injector through the pipe 30 and the passage in the valve 44 to the pipe 30′, and thence to the exhaust-heater; the course through that has already been explained. After passing through it, it enters the fire-heater, as described, and escapes at its top through a connection, 39, and the pipe 40 to the valve 44, and through the passage shown to the check valve 41, and thence to the boiler. In case of the failure of any part of the heater, so that it would be necessary to shut off the water from it, the plug 45 of the valve 44 would be turned into the position represented by dotted lines. The water would then flow from the pump through the pipe 30 and the passage in the valve directly to the check valve and boiler, and the pipes 30′ and 40 would be shut off from it. At the same time the door 1 1 in the smoke-box would be opened, so that the smoke and gases would escape direct up the chimney, and thus would not pass through the fire-heater tubes. By these means the engine would not be disabled

*Fig. 4 is a half view of the end of the heater, looking at it in the direction indicated by the dart *c*.

by the failure of the heater, and, in fact, if it was important to do so, the position of the plug of the valve 44 could be changed and the door in the smoke-box be opened without stopping the engine.

In many places water must be used which contains ingredients which form a hard deposit, and which can only be removed by having free access to the surfaces on which the incrustation is deposited. The provisions for giving access to the tubes of the exhaust-heater have been described, but if the tubes of the fire-heater should become incrusted with hard deposit, it would be impossible to remove it except by taking out the tubes. To provide for this contingency, the fire-heater shown in Figs. 8-11 was designed. It consists of longitudinal horizontal water tubes, so disposed that they can be removed from the smoke-box whenever it may be desirable to do so to clean or repair them. The exhaust-heater 26 has curved tubes, and, being substantially similar to that shown in Figs. 1 to 5, need not be again described. The tubes 5 of the fire-heater, Fig. 8, are placed horizontally and set longitudinally in the extended smoke-box 13, to the front of which a number of cast-iron sectional headers, 58, are bolted. These are made with double plates and a water space between them, and are of a width sufficient to take three, or may be made to take any other number of vertical rows of heating tubes. The tubes are attached to the inner plates of the headers in pairs, and the adjoining back ends of each pair of tubes are connected together by a U connection, 59. Between the two tubes of each pair a division, 60, is formed in the headers. These divisions are shown in Fig. 8 and also in Fig. 10, in which one header, 58, is represented in transverse section. The feed water is conducted from the exhaust-heater to the fire-heater through the openings and pipe 35, Figs. 8 and 10. The different headers have water passages, 76 76, Fig. 10, at their upper and lower ends, connecting those which adjoin each other. The water when it enters through the pipe 35 (see Fig. 10) can flow from one header to the other (as indicated by the dotted arrows on the left of 35) and into the lowermost of the tubes 5 (see Fig. 8), and backward through them to the U bends, 59, by which these tubes are connected to those next above them, and then forward through the second row of tubes to the next compartment in the header above the lowermost one, as indicated by the arrows in the figure. The water can then again flow backward through the third row of tubes from the bottom and forward through the fourth row to the header, and so on until it reaches the top row and the top of the headers. It then flows in the direction indicated by the dotted arrows in Fig. 10, above the top row of tubes, then out through the nozzle 39, and is conducted by the pipe 40 to the check valve 41 (shown in Figs. 8 and 10), and thence to the boiler.

In order to give access to the inside of the bends 59, plugs 70 are screwed into their back ends. By unscrewing these any scale or deposit which may accumulate in the bends may be removed.

In order to be able to handle the heater conveniently, the headers and tubes connected to them are suspended by a bolt, 63, attached to the top of the system of headers upon a species of crane, 64, a partial plan of which is shown by Fig. 9.

The weight of the heater, which will be about 10,000 pounds, may be urged as an objection to it. With mogul and consolidation engines this must be carried on the pony truck in front, and it may in some cases be essential to increase the size of the axles and other parts of the truck to carry this extra weight, but in new engines there will be no difficulty in distributing the weight and proportioning the parts satisfactorily.

From the preceding description it will be seen that this heater has the following advantages:

1. An ample amount—over 1,000 square feet—of heating surface.
2. The insides of all the water tubes are accessible and can be thoroughly cleaned, caulked or be replaced from the outside of the locomotive.
3. They are all entirely free to expand and contract, thus relieving them and the parts to which they are attached from strains and consequent deterioration and corrosion.
4. The fire-heater shown in Fig. 8 can be readily removed from the smoke-box and be cleaned externally or repaired.
5. If any part of the heater should fail the water and waste gases can be shut off from it, and the water fed direct into the boiler, and the waste gases be conducted to the chimney, so that the engine will not be disabled by the failure of the heater.
6. The only care which will be required to operate the heater will be to remove the sediment and incrustation from the tubes.

The cost of the heater has not yet been ascertained, but if it will lessen the consumption of coal from 25 to 30 per cent., increase the capacity of the boiler in like proportion, arrest the solid constituents of the water before they enter the boiler, and consequently materially reduce the cost of boiler repairs, and keep the engine in service a greater proportion of the time, these advantages should be some indication of its value to railroad companies.

The Dayton Draft Gear, manufactured by the Dayton Malleable Iron Company, of Dayton, Ohio, is the subject of a 24-page pamphlet just issued. It discusses the origin and design of the gear, the construction and tests at Purdue University, and illustrates seven different arrangements of the elements as used by well-known railroads. These are illustrated by half-tone engravings on one page and corresponding line drawings upon the opposite page, the engravings being excellent. One of the tests recorded indicates that the gear, after sustaining a loan of 250,000 pounds for a period of 12 hours, was still in condition for service. The catalogue gives the information wanted concerning this gear by railroad officers.

MASTER CAR BUILDERS' ASSOCIATION.

THIRTY-SIXTH ANNUAL CONVENTION.

Abstracts of Reports.

OUTSIDE DIMENSIONS OF BOX CARS.

Committee—C. A. Schroyer, G. W. Rhodes, W. P. Appleyard, Joseph Buker, J. N. Barr.

At the meeting of the American Railway Association, held April 24, 1901, the following principle regarding the construction of box cars was approved:

"That the essential elements of the standard box car require that the height and width be as great as are permitted by the physical limitations of the important railroad clearances and the present established height of loading platforms; that the length be determined by economy in construction, maintenance and operation and the requirements of economical storage."

At the convention of the same association, held in St. Louis on October 23, 1901, in pursuance of the above principle a Committee on Standard Dimensions of Box Cars submitted a report in which the following resolution was offered for adoption:

"Resolved, That the dimensions of the standard box car be 36 ft. in length, 8 ft. 6 ins. in width, and 8 ft. in height, all inside dimensions. Cross section, 68 square feet, capacity 2,448 cubic feet. The side-door opening to be 6 ft. in width."

On a vote by the roads the above resolution was adopted, there being but one dissenting vote. The cross-section and longitudinal measurements are the dimensions between lining, the vertical measurements being from top of floor to under side of carline. During the discussion of the above report the following resolution was adopted:

"Resolved, That the Master Car Builders' Association be requested to consider and adopt the required external dimensions for the standard box car, based upon the interior dimensions as prescribed by the American Railway Association."

Upon receipt of advice from the American Railway Association to the above effect, the president of this association appointed the above mentioned committee to consider and report at this convention such external dimensions as would meet the requirements of a car with the inside measurements agreed upon.

The above is a brief outline of the facts leading up to the formation of your committee.

Believing the essential elements of the box car to be as stated in the principles enunciated above, your committee carefully considered the physical limitations of clearances, etc., of the railroads of the country, bearing in mind the further limitations prescribed for inside dimensions by the American Railway Association, and submitted to the members of this association certain outside dimensions, as follows:

For a box car set on trucks used as standard, where the height from top of rail to top of floor is 4 feet:

	Feet.	Inches.
Height, top of rail to upper edge of eaves........	12	6¾
Width at eaves, at above height, maximum.......	9	7⅜

For a box car set on low trucks, where the height from top of rail to top of floor is 3 ft. 6 ins.:

	Feet.	Inches.
Height, top of rail to upper edge of eaves........	12	¾
Width at eaves, at above height, maximum.......	9	10

The members of the association were asked to state whether or not they approved of the above dimensions; if not, wherein they should be modified to meet existing conditions. From the replies to this circular it was found that the exterior dimensions given above were satisfactory to a majority of the roads, but on certain trunk lines there were clearance limits which would not permit cars set on low trucks (3 ft. 6 ins.), of the cross section given (9 ft. 10 ins.), at the height of 12 ft. ¾ in., to pass.

To meet these conditions your committee has decided to modify its original recommendation in this respect, and would suggest 9 ft. 7 ins. as the maximum width at eaves at a height of 12 ft. ¾ in., and for the sake of uniformity would also change its original recommendation as regards the width at eaves of cars set on trucks, with 4 feet in height to top of floor, from 9 ft. 7⅜ ins. to 9 ft. 7 ins., thus giving a standard width for cars of either height.

In the determination of the above figures the following dimensions have been used:

VERTICAL DIMENSIONS.

For a box car set on high trucks (4 ft. to top of floor):

	Feet.	Inches.
Height, top of rail to upper edge of eaves............	12	6¾

DETAILS.

	Feet.	Inches.
Top of rail to upper face of floor....................	4	0
Upper face of floor to under edge of carline...........	8	0
Width of carline at end where secured to plate........	0	3 13-16
Thickness of rafter to which metallic roof is applied...	0	1⅝
Thickness of purline to which roof boards are secured..	0	1⅛
Thickness of roof boards..............................	0	13-16
	12	7⅜
Less pitch of roof from inside edge of plate to outside edge of eaves..................................	0	⅝
Total	12	6¾

CROSS SECTION.

	Feet.	Inches.
Width at eaves, at above height maximum	9	7
DETAILS.		
Width between lining	8	6
Thickness of lining	0	1⅝
Thickness of siding	0	1⅝
Thickness of posts and braces	0	6
Air space between fascia boards	0	1
Thickness of fascia boards	0	1⅝
Projection on each side for roof, 9-16 in	0	1⅛
Total width	9	7

VERTICAL DIMENSIONS.

For a box car set on low trucks (3 ft. 6 ins. to top of floor):

	Feet.	Inches.
Height, top of rail to upper edge of eaves	12	¾
DETAILS.		
Top of rail to upper face of floor	3	6
Upper face of floor to under side of carline	8	0
Width of carline at end where secured to plate	0	3 13-16
Thickness of rafter to which metallic roof is applied	0	1⅝
Thickness of purline to which roof boards are secured	0	1⅛
Thickness of roof boards	0	13-16
	12	1⅜
Less pitch of roof from inside edge of plate to outside edge of eaves	0	⅝
Total height	12	¾

CROSS SECTION.

	Feet.	Inches.
Width at eaves, at above height maximum	9	7
DETAILS.		
Width between lining	8	6
Thickness of lining	0	1⅝
Thickness of siding	0	1⅝
Thickness of posts and braces	0	6
Air space between fascia boards	0	1
Thickness of fascia boards	0	1⅝
Projection on each side for roof, 9-16 in	0	1⅛
Total width	9	7

In determining height from top of rail to upper face of floor of 4 ft., the following dimensions were used:

	Feet.	Inches.
Rail line to center line of drawbar	2	10½
One-half of drawbar stem	0	2½
Clearance between drawbar stem and under side of sill	0	¼
Thickness of sill	0	9
Thickness of floor	0	1¾
Total	4	0

Where the height from top of rail to upper face of floor is 3 ft. 6 ins., the following dimensions were used:

	Feet.	Inches.
Rail line to center line of drawbar	2	10½
One-half of drawbar stem	0	3
Width of sill above gain for drawbar, the floor to be rabbeted into sill	0	4½
Total	3	6

The inside measurements having been established by the American Railway Association, and the outside dimensions being confined to the limiting clearances of the leading trunk lines, the committee has carefully considered the various forms of framing which have been submitted to it, in order that the best possible construction may be had between these limitations, and it submits for your consideration what it believes to be a substantial box-car framing, which will carry the loads required and make a strong car in every particular.

Your committee would recommend that on all cars built to these dimensions the words and letters "Standard, 12 ft. 6¾ ins. by 9 ft. 7 ins." be stenciled in letters not less than three inches in height on the end fascia boards.

Your committee would also recommend that the dimensions for inside measurements of box cars, as prescribed by the American Railway Association, be adopted as the standard of this association.

SIDE DOOR.

The American Railway Association has recommended that the side-door opening for the above car be 6 ft.

Your committee finds that there is much objection from the mechanical standpoint to the 6 ft. width of door opening, for the following reasons:

1. It weakens the framing of the car, both on the sill and plate lines.

2. The increased size in the width and height of the side door makes it extremely difficult to construct a door which will remain straight and prevent binding on the sides of the car, which has always been found to be very objectionable and destructive to both siding and door, because of the indifferent manner in which our doors are manipulated at the freight houses.

3. On the grain-carrying roads it would necessitate the use of a grain door so heavy and large that it would be impracticable for one man to handle it; additional complications would be entailed in its construction, and it would necessitate carrying in stock additional thicknesses of lumber in such sizes as not to be readily obtainable.

Your committee, while it has recommended for adoption as standard external dimensions which it believes adequate for strength for cars of the inside dimensions adopted by the American Railway Association, and has presented for your consideration certain details of car framing to meet these external dimensions, does not recommend these latter details for adoption. It believes that the time is now here for the adoption by this association of a standard box-car framing, and it would recommend that a committee be appointed to propose for adoption as standard, at our next convention, a system of framing for box cars with inside and outside dimensions as above.

A brief summary of the recommendations herein mentioned is as follows:

1. That the inside dimensions of box cars as approved by the American Railway Association, namely, 36 ft. long, 8 ft. 6 ins. wide and 8 ft. high, be submitted to letter ballot for adoption as standard:

2. For box cars on high trucks (4 ft. to top of floor):

	Feet.	Inches.
Height, top or rail to upper edge of eaves	12	6¾
Width at eaves, at above height, maximum	9	7

be submitted to letter ballot for adoption as standard.

3. For box cars on low trucks (3 ft. 6 ins.):

	Feet.	Inches.
Height, top of rail to upper edge of eaves	12	¾
Width at eaves, at above height, maximum	9	7

be submitted to letter ballot for adoption as standard.

4. That the words and letters "Standard, 12 ft. 6¾ ins. by 9 ft. 7 ins." be stenciled in 3-inch letters on the end fascia boards on all cars built to these dimensions.

5. That a committee be appointed to report at the next convention a detailed form of framing for box cars, for adoption as standard.

DRAFT GEAR.

Committee—E. D. Bronner, G. F. Wilson, Mord. Roberts, W. W. Kiesel, Jr., T. A. Lawes, C. M. Mendenhall, J. F. Deems, Wm. Forsyth.

At the convention of 1900 a Committee on Draft Gear was appointed, with instructions to report on the requirements of modern draft gear to meet modern conditions, spring capacity, sizes and strength of parts, excluding drawbar, prepare methods of attaching to sills of cars and submit recommendations and drawings covering principles.

At the convention of 1901 a preliminary report was made, outlining in a general way its proposed plan of action. The committee was continued, with instructions to carry its plan into operation.

Pursuant to these instructions, at a meeting of the committee, held in Chicago, October 8, 1901, a preliminary plan of tests was proposed, and it was decided to request the draft gear makers and those of our members interested in this work to meet the committee at a session to be held at the Auditorium Hotel, Chicago, on Wednesday, November 20, 1901, at 10 o'clock A. M., to discuss this proposed plan of tests. The object of this meeting was to bring out criticisms and suggestions, to the end that the tests as determined and agreed upon beforehand would be satisfactory to all concerned.

The Pennsylvania R. R., through Mr. W. W. Atterbury, General Superintendent Motive Power, kindly gave the association the use of its drop testing machine at Altoona, Pa., for drop test purposes. Likewise Purdue University, through Prof. W. F. M. Goss, gave the association the use of its 300,000-pound capacity tensile testing machine, at Lafayette, Ind., for tensile and compression tests.

Quite a number of the draft gear manufacturers met with the committee on the date named, and after a free discussion of the preliminary plan of tests, the following plan was agreed upon:

Nature of Tests.

First—Tests under the standard M. C. B. drop testing machine.

Second—Tests in a 300,000-pound capacity tensile testing machine.

These tests are expected to show the efficiency of the different riggings and their relative standing under shocks and under steady pulls.

Testing Apparatus.

The drop testing machine used to be the one at Altoona, Pa., owned by the Pennsylvania Railroad and built according to M. C. B. standards, and shown in the Proceedings of the Association. The limit of this machine is a drop of 40 ft., and the weight is 1,640 pounds.

The tensile and compression testing apparatus used to be the Riehle screw machine at Purdue University, Lafayette, Ind. It has a capacity of 300,000 pounds, and it is fitted with an automatic beam of such dimensions as to allow tensile and compression tests to be made on specimens 8 ft. long and less, and permits of any length of draft rigging which can be used on a car.

Specifications for Mounting Draft Rigging for Tensile and Compression Tests.

Manufacturers will be required to furnish two draft riggings complete, already fitted to sills to suit the tensile testing machine at Purdue University. One rigging will be used for pulling and one for compression test. The riggings may be attached to either 10-in. steel I-beams or 5 x 9-in. oak timbers, the spread varying from 9 to 23 ins. for the steel and 9 to 18 ins. for the wood construction. In addition to the draft rigging, manufacturers will only be required to furnish the I-beams or oak timbers properly fitted, as shown by detail drawings, and the cast-steel dummy couplers. The eye bolts, pins, crossbar, rods and caps will be used in all the tests and be furnished by the committee.

Drop Tests.

One sample of each kind of rigging, approved by the committee and properly mounted, will be required for the drop tests. For drop

test purposes, draft riggings will be divided into two classes, as follows:

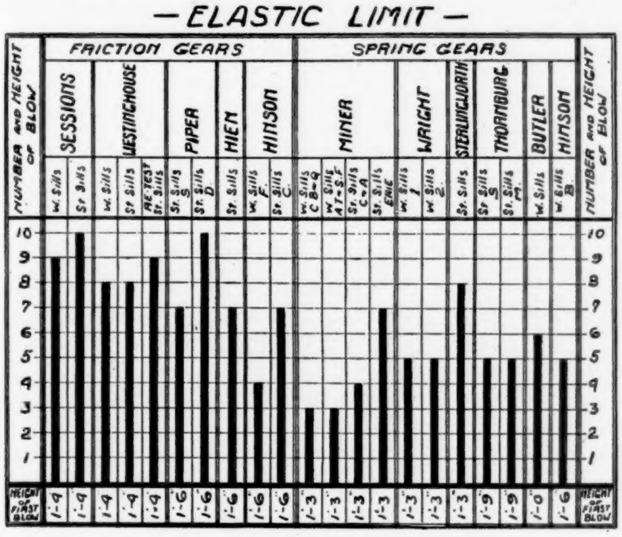
Class I., underhung draft rigging for cars with wood or metal draft sills where the draft attachments are not blocked between the body bolsters.

Class II., draft riggings placed between the center sills, and also cars where underhung draft attachments are well blocked to the body bolsters and well blocked between the body bolsters.

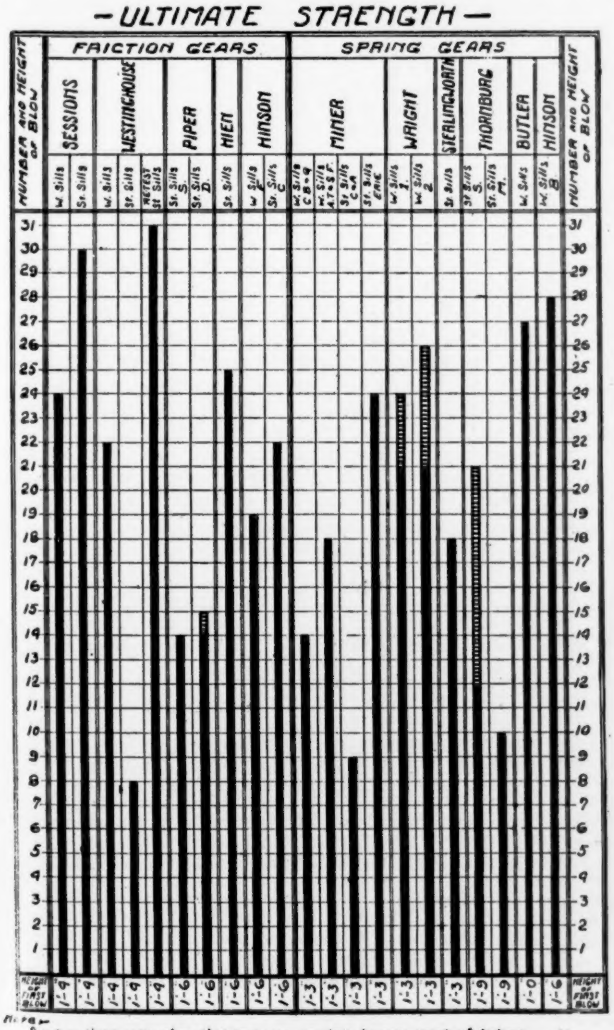
It is anticipated that different results will be obtained from the testing of these two classes of riggings. Riggings included in Class I. will first be tested as applied to cars. If the fastenings begin to fail, then blocking will be put in between the attachments and the anvil and the draft attachments will be tested to destruction. If necessary, Class II. riggings will be blocked in the same manner.

If any part fails in the test, that part may be replaced once, provided it is thought desirable by the committee.

—ELASTIC LIMIT—



—ULTIMATE STRENGTH—



Note— Section lined parts show that test was carried beyond point of failure.

In testing under the drop, the test will begin with a drop of 1 ft., and the height of drop will be increased by intervals of 1 ft., one blow each, until the rigging is destroyed. A tup of 1,640 lbs. weight will be used, striking the face of the dummy coupler. When parts are replaced, the test will be carried on from the point where the test was discontinued on account of the broken part.

Tensile and Compression Tests.

Two samples of each kind of draft rigging, approved by the committee and properly mounted, will be required for these tests. One rigging will be tested in tension and the other in compression. These tests will be carried to the capacity of the machine, 300,000 lbs., provided the riggings do not previously fail. Curves will be obtained, showing the relation between the load and the movement of the coupler. The load will be removed at frequent intervals before the draft rigging is injured,so as to ascertain its condition and its behavior on release of load. The points at which any failures occur will be noted in detail. If any part fails in the test, that part may be replaced at once, if it is thought desirable by the committee.

The following definitions of terms were adopted for use in connection with the work of the committee:

Draft Rigging.—A general term, implying the whole combination of draft attachments and coupler attachments.

Draft Attachment.—The parts of the draft rigging attached to center sills of the car, including sill plates, carrying irons, etc.

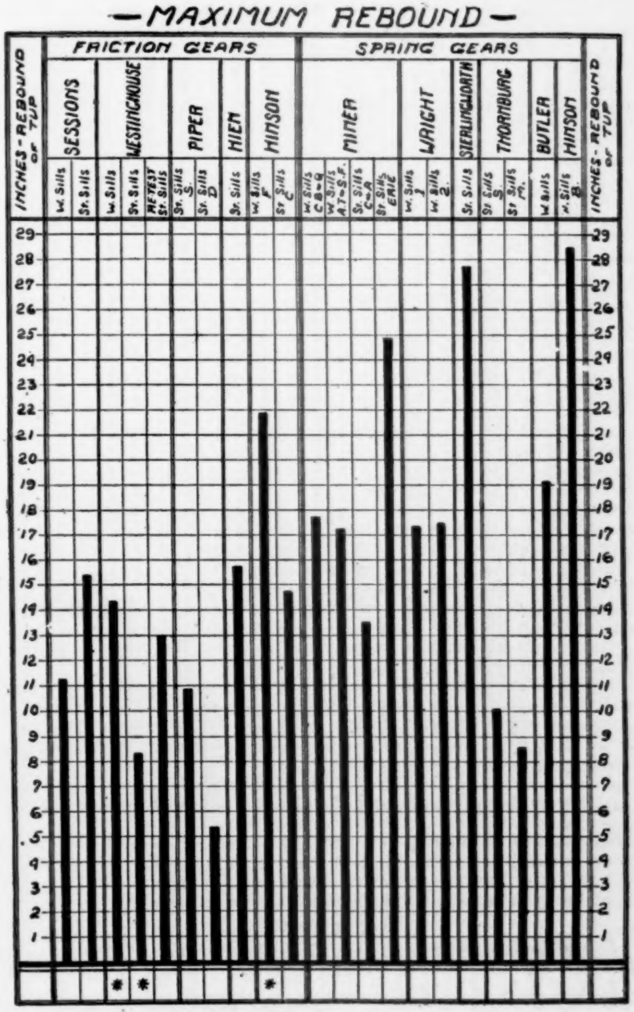
Coupler Attachments. — The parts of the draft rigging attached to the coupler and included within the yoke, such as the yoke, springs and followers, or their substitutes.

In accordance with the arrangements had at this meeting, ten draft gear manufacturers submitted designs for testing, the understanding being that each manufacturer should be permitted to witness only the test of his own device, the details of the tests to be presented in full to this convention. Your committee has, therefore, thought it advisable to give in detail the result of tests, which it is hoped will prove of interest.

On account of the extent of the tests, the large number of gears tested and reported on and the amount of work required to put the results in shape, it has not been possible at this time to do anything more than present the facts as shown by the tests. The committee, therefore, has not attempted to draw any conclusions from the tests or to make any comparisons of the various gears.

Your committee is of the opinion that, in order to fully carry out the instructions given by the association as to the nature of a final

—MAXIMUM REBOUND—



* Rebound still increasing when gear failed

Diagrams Showing Results of Tests on Draft Gear.

report on the subject of draft gear, that a series of road tests is necessary, whereby a record can be kept for a given period of the repairs necessary to the draft gear itself and to the other parts of the car independent of each other; also that a record be kept of the car mileage and tons hauled during that period, and it would recommend that a committee be appointed to carry these tests to a conclusion. It would then be possible to design a draft gear in conformity to the original instructions given the committee by the association.

STANDARD METHODS OF CLEANING AIR BRAKES.

Committee—C. H. Quereau, F. H. Scheffer, W. E. Symons.

After carefully considering the matter we have decided that there cannot well be standard methods of cleaning air brakes because of the varying conditions and facilities, any more than there can be standard methods of doing any other work. Dimensions and designs can be made standard, but we believe it will be best only to recommend standard practice for methods of cleaning air brakes. With this understanding the following is offered:

The brake cylinder and its parts need not be removed from the car for cleaning. First, secure the piston rod firmly to the cylinder head, then, after removing the cylinder head, piston rod, piston head and release spring, scrape off all deposits of gum and dirt with a narrow putty knife and place the removed parts in kerosene or other light oil, leaving them there until the inside of the cylinder is thoroughly cleaned. Particular attention should be paid to cleaning the leakage groove and the brake cylinder tube. Then clean the parts which have been soaking, removing the packing leather and expanding ring for proper inspection and cleaning. When the expanding ring is free its ends should be from 1¼ to 1½ ins. apart. In all cases the follower nuts should be drawn up snugly before replacing the piston head and the inside of the cylinder and the packing leather evenly coated with a suitable grease or vaseline. No sharp tool should be used in getting the packing leather into the cylinder. After the piston is in place and before the cylinder head is fastened on, the piston rod should be moved in all directions about 3 ins. from the center line of the cylinder, in order to be certain that the expanding ring is not out of place. The cylinder should be stenciled with the date of cleaning, using white lead, and if on a foreign car, a repair card should be attached, as provided by the rules. The bolts or nuts holding the cylinder and reservoir to the car should be tightened.

The triple valve should be removed from the car for cleaning in the shop, to be replaced by a triple in good condition. It should be dismantled and all the parts, except those with rubber seats, immersed in kerosene to soften the accumulated oil and gum. No metal tool should be used to remove gum or dirt or loosen the piston packing ring in its groove, as the almost inevitable result will be damage to some vital part of the triple. Particular pains should be taken in cleaning the feed groove not to enlarge it. Rags, or better still, chamois skins, should be used rather than waste, as the latter invariably leaves lint on the parts on which it is used. Great care must be used in removing the emergency valve seat, as this is frequently found bruised and distorted in triples which have been cleaned. The working parts should be carefully examined to know they are in good order. Particular attention should be given the triple piston packing ring, the ends of which should not be more than 1-64 in. apart when the piston is in its bush, and should be a neat fit in its groove and the triple piston bushing. The bushing should be true and without more than a barely perceptible shoulder in it. The graduating stem nut should be cleaned of dirt and rust, the graduating stem work freely in its nut, and the graduating spring be of standard dimensions. The slide valve, triple piston packing ring and bushing should be lubricated with a very few drops of signal oil, but the emergency piston, valve and check should not be oiled.

Should the triple piston packing ring need to be removed or the bushing require truing, we strongly recommend that this work be done by the manufacturers. We are thoroughly convinced that the average workman cannot, at least does not, do work of this kind satisfactorily, and that by far the largest proportion of the attempts to economize in this way result in inefficient air brakes and slid flat wheels.

Usually sufficient attention is not paid to the condition of the emergency parts of the triple, as shown by their condition; the emergency valve seat is found distorted, the stem bent, the rubber seat imperfect and the check valve not properly fitting in a number of cases. These facts account for a large number of slid flat wheels.

The cylinder cap gasket and check valve case gasket should be carefully examined and cleaned by using a cloth. They should not be scraped with a metal tool. Judging an examination of a number of triples, these gaskets should be renewed more frequently than they are.

Before assembling the parts after cleaning, the casings and body of the triple should be thoroughly cleaned out with a blast of compressed air.

In replacing the emergency parts the greatest care should be exercised not to injure any of them when tightening the cap screws.

When replacing the triple on the auxiliary reservoir the gasket should be fitted to the triple instead of the reservoir.

Testing Triples.

After cleaning and repairing it is essential that triples be tested and come within required limits, if a reasonable efficiency of the air brakes is to be maintained.

Test No. 1.—The tightness of the slide valve, the emergency and check valves and all points should be determined by painting with soap suds.

Test No. 2.—Maintaining a pressure of 90 pounds in the train pipe, the auxiliary pressure should reach 70 pounds in not less than 45 seconds or more than 60 seconds, as provided in test No. 9 of the M. C. B. Air Brake Tests.

Test No. 3.—To test repaired triples for release, charge the auxiliary to 70 pounds pressure and make a full service reduction of 20 pounds, or until the auxiliary and cylinder pressure are equal. Place the special cut-out cock in such position that pressure must pass through the 3-64-in. port, and turn main-reservoir pressure of 90 pounds into the train pipe. If the triple does not release under these conditions it should be condemned.

Test No. 4.—The triple piston packing ring should be tested for leakage by blocking the piston in the graduating position, maintaining the train pipe pressure at 70 pounds. Under these conditions the pressure in the auxiliary reservoir should not increase faster than 15 pounds per minute.

[Editor's Note.—The report concludes with schedules of prices for labor in cleaning and repairing.]

CAST-IRON WHEELS.

Committee—J. N. Barr, William Garstang, J. J. Hennessey, D. F. Crawford, William Apps.

Owing to circumstances beyond control, the committee was not able to get satisfactory information on the subject. This is particularly the case with reference to the wheels for cars of heavy capacity, which have been coming into vogue for the last two years; in fact, it is believed that the information on this subject is, so far, quite indefinite and fragmentary, and that insufficient experience with cars of this character does not permit of any very definite statements.

The practice for weights of wheels under 100,000-lb. capacity cars varies from a minimum of 630 lbs. to a maximum of 750 lbs. As there seems to be a great discrepancy in this respect, the committee considers the matter of sufficient importance to recommend the continuance of the committee for the coming year, to pay direct attention to the developments which may arise in this direction. This is especially important in view of the fact that some roads have considered the matter so seriously as to go, to a certain extent, into the use of steel wheels.

The question of recommending minimum weights of wheels for different classes of cars, so that at interchange points, if the wheels do not meet these figures, the cars may be refused, is one which is very difficult to deal with. If one railroad company, in order to avoid undue weight of wheels, goes to the expense of using high-priced material, it would be an injustice to it to put it on the same footing as in the case of the use of wheels of miscellaneous and undefined mixture of metal, and these railroads would be put in an undesirable situation by making a high maximum. By making a low maximum weight, that is not safe for some metals frequently used in wheels, it would leave railroad companies without proper protection.

The committee is inclined to think that the majority of railroad companies are necessarily compelled to go to the weight of wheels which gives satisfactory service on their own line, and believes that if a rule were made to prevent putting wheels of less than a given weight on certain capacity foreign cars, that the interchange requirements would be as closely met as it is practicable to do at the present time.

The committee believes that this is one of the most important matters before the association; that with the development and manufacture of larger capacity cars the circumstances are shifting rapidly, and the committee recommends that the subject should be continued for another year.

In conclusion, your committee would recommend that a careful record be kept by the members for the purpose of furnishing information to this association of all cases of breakage of wheels, giving the following information:

1. Weight of wheel. 2. Capacity of car. 3. Character of breakage. 4. Track circumstances, as far as the grade is concerned; that is, whether the breakage occurred on a grade or near the terminus of a grade of a given length. If any grades are found specially troublesome, a plan showing profile and curvature would be especially valuable.

The terms descriptive of breakages should conform, as far as possible, with the terms adopted by this association.

CODE OF RULES FOR EXAMINATION OF CAR INSPECTORS.

Committee—G. W. Rhodes, M. K. Barnham, Chas. Waughop.

In determining the proper age for inspectors we have had to bear in mind that vision and hearing, so important for men in this line of railroad work, begin to fail at 40 years of age. Glasses then become necessary, and glasses are not always successfully used in outdoor active work in all kinds of weather by car inspectors.

It has also been thought wise to map out a line of work that seems most desirable for the schooling of inspectors. The committee recommends:

One year at oiling cars.
Two years at car repairing.
Age limit for new men, 30 years.
Age limit for promoted men, 40 years.
Vision, 20-20 in one eye and not less than 20-40 in the other, without glasses.

Method of Testing.—Acuity of Vision.—The test card should be hung in a good light and the party to be examined should, if possible, be seated with his back to the window. Each eye should be examined separately, using, for the purpose of excluding one eye, a

folded handkerchief. The lowest line that can be read should be determined by exposing only one letter at a time through a hole cut in a strip of cardboard. In making out the report in each case, the visual acuity of each eye should be denoted by a fraction of which the numerator represents the number of feet at which the applicant is seated from the card, while the denominator represents the number of feet at which the lowest line which he can read should be read. Thus, if at 20 ft. he reads the line marked 20 ft., his vision—20-20 or 1, which is the normal standard. If at the same distance he can only read the line marked 70 ft., his vision—20-70. If at 20 ft. he reads the 15-ft. line, the vision—20-15, or more than normal. If a room 20 ft. long cannot be used, a testing distance of 15 or 10 ft. should be employed, in which case normal vision would be represented by a 15-15 or 10-10 respectively, and lower grades of vision by such fractions as 15-20, 10-70 and so on.

Field of Vision.—Test should be made by having the applicant and examiner stand about 3 ft. apart, each with one eye shut, looking each other steadily in the eye. The examiner should then bring his hand in from the edge of the field toward the center of the space, between them, until the applicant sees it coming. This should be done from different directions, up, down, and from each side. The applicant should see the hand coming about as soon as the examiner does. If not, this should be noted on the report.

Hearing.—Test should be made in a quiet room. First, the examiner should hold the watch opposite the ear to be examined not less than 48 ins. distant, then gradually approach the ear until the applicant hears the tick, the stop being used to satisfy the examiner that the applicant is not deceiving. The distance at which the applicant hears the watch should be noted in inches. The normal ear should hear the tick of the watch at 48 ins. Then the hearing power will be denoted by a fraction whose numerator represents the number of inches at which the watch is heard. Thus, if he hears the watch at 48 ins. his hearing—48-48, or normal. If he hears it at only 10 ins. distant his hearing—10-48, and so on.

Color.—The committee does not think it essential that inspectors should be rejected on account of imperfect color sense. It is, however, believed that inspectors should be tested as to their color sense so that they, as well as their employer, may know their condition in this respect.

Educational.—The applicant should be able to write a legible hand in English, and also to read manuscript matter as well as printed matter.

Car Knowldege.—The inspectors should be able to name each part of the cars in general use, in preference using M. C. B. dictionary terms.

M. C. B. Rules.—Inspectors must pass a satisfactory examination on M. C. B. Rules, answering 75 per cent. of the questions submitted. (Sample questions conclude the report.)

STANDARD AXLES AND SPECIFICATIONS FOR SAME.

Committee—E. D. Nelson, Wm. Garstang, Jas. Coleman.

The present M. C. B. specifications for axles have been in force since 1896, and therefore the oldest axles made according to these specifications are not more than six years old. The practical results, judged by the service these axles have given, lead your committee to believe that no serious errors have been made in either the design or the character of the steel specified. It is too soon, however, to speak positively on these questions, because an axle somewhat low, with proper dimensions, or of material somewhat inferior to what it should be, does not break as soon as it is put in service, but fails eventually, due to the constant reversals of strain in service, and this must be repeated many thousands of times in order to result in failure. It is not thought that six years of service is sufficient to determine whether an axle of given design and material has proved successful.

Furthermore, a very large proportion of the axles made since 1896 are much less than six years old, and consequently it would not be reasonable to look for failure unless there was some serious defect in the design or material. The next two or three years will probably furnish some reliable data in connection with the axles designed according to these specifications that may be withdrawn, having worn out in service.

As to the possibility of making limiting weights and dimensions for axles, your committee does not feel that this is necessary. The dimensions adopted for different portions of the axle should be followed as closely as it is possible to do in practice, and by introducing the question of the limit of weight it simply becomes a disturbing factor.

Further, cases have come to the attention of your committee where axles bought on specifications requiring minimum weights have been found less in diameter at certain portions of the axle than required by the present M. C. B. drawings, and this, as is readily seen, will result in the axle being overstrained in that portion where it is less than the proper diameter.

In general, your committee feels that the present specifications should stand for another year at least, and until some definite information can be obtained which would lead to modifications.

The committee on axles, reporting to the convention of 1901, recommended that the wheel seats of M. C. B. axles should be changed in order to allow more material for refitting wheels to the following dimensions:

Axle "A"	5⅛ ins.	Axle "C"	6½ ins.
Axle "B"	5¾ ins.	Axle "D"	7 ins.

And in addition that the center of axle "B" be made 4¾ ins.

These recommendations were submitted to letter ballot, which closed September 14, 1901, the result of which was that the recommendations were adopted by the association. When the drawings of these axles appeared in the proceedings of 1901, however, changes were made in the diameter of the tapered portion of the axle where it joins the fillet next to the rough collar. The diameter at this point should be approximately the same as that of the wheel seat when turned down to its limit, although somewhat less. It was also found that the diameter of the rough collar was insufficient from a practical standpoint, in order to have this collar fulfill the functions for which it was designed.

After consulting a number of axle manufacturers, it appears necessary to have the diameter for the rough collar about ⅜ in. greater than the finished wheel seat. The usual practice in the forge shop, when axles are smooth-forged, is to make the diameter of the rough collar and wheel seat the same, allowing ¼ in. on the diameter for finishing, and, therefore, in this case the rough collar would be ¼ in. greater in diameter than the finished wheel seat. When the wheel seat is rough turned by the manufacturer, the diameter of the rough collar and the wheel seat are forged the same, but are made from ⅜ in. to 7-16 in. greater than the finished wheel seat. This allows ¼ in. to be taken off in rough turning, and still leaves ⅛ in. on the diameter of the wheel seat for finishing when wheels are fitted on the axles.

Your committee submits with this report drawings of the M. C. B. axles A, B, C and D, showing the changes which they think necessary as referred to above, all of which is respectfully submitted.

LABORATORY TESTS OF BRAKE SHOES.

Committee—J. E. Simons, Geo. Gibbs, L. T. Canfield.

The committee report presented at the association meeting of 1901 was rather exhaustive and covered the question of tests so thoroughly that there was nothing for this committee to do except to ascertain as far as possible what efforts were being made by the members of the association to adopt the coefficient of friction as recommended by the committee and later adopted as standard by this association.

Your committee therefore made inquiry by circular as to whether any of the members desired it to test the shoes being used, and the replies received from that inquiry would indicate that a very large percentage of the members are using shoes that were tested by our predecessors, and as the results obtained are satisfactory in nearly all instances, the necessity of another test so soon after the adoption of the coefficient of friction as standard, was evidently considered as premature, and consequently no tests were made.

In connection with the Circular of Inquiry, the committee deemed it advisable to ascertain, if possible, the result of the continuous application of brakes on grade. From the replies received, the indications are that the results in some cases are disastrous to the wheels, causing overheating and checking of the tread, eventually forming comby spots and circumferential cracks in or adjacent to the throat, and surface cracks across the tread normal to the flange.

It has not been definitely determined, however, that the long-continued application of the brake is the real cause of this, but the fact that these conditions exist on roads having long, steep grades, more prominent than on roads having light grades, would make it appear that there is room for further investigation along the lines of the effect of temperature, and that some effort should be made to obtain more knowledge in regard to the friction of brake shoes and its effect upon cast-iron wheels under heavily loaded cars by continuous application of the brakes.

Your committee is of the opinion that steps should be taken wherever possible by members of the association, to check the results obtained by the Committee on Laboratory Tests of Brake Shoes, by making practical tests in actual service of shoes having the frictional qualities of the recommended standard.

If members will in this way co-operate with the committee, it seems probable that additional facts of value will be obtained for the use of the association.

SUBJECTS FOR INVESTIGATION AND REPORT NEXT YEAR.

Committee—C. A. Schroyer, F. W. Brazier, A. E. Mitchell.

1. To submit drawing of a proposed standard steam coupling with outlet same size as steam pipes; (a) to suggest a proper distance from center of car and from top of platform; (b) to consider the best system of admission valves, and other matters pertaining to train line pipes and steam hose.
2. To submit drawing for a uniform shape of brass and wedge, and report upon the extent to which variations now exist from standard.
3. To consider and report upon a proper method of handling condensation in air brake equipment and best means of preventing ice forming in train line and hose connections.
4. To consider and report upon the use of collarless journals. What have been the results? Do they create more hot boxes? What is a safe limit to allow them to run?
5. To consider the difficulties existing because of variations in shapes and sizes of M. C. B. journal box wedges; best methods to obtain uniformity.
6. To propose a standard for signal lamp brackets and sockets, and location for same on end of passenger cars.
7. To submit drawing of proposed standard pedestal and oil box for passenger cars with axles having 5 and 9 journals.

STANDARD PIPE UNIONS.

Committee—B. Haskell, W. H. Lewis, Thomas Fildes.

Originally there was a committee appointed by this Association, the American Railway Master Mechanics' Association and the American Society of Mechanical Engineers, to consider the subjects of (1) Square Bolt Heads and Nuts, (2) Standard Pipe Threads, and (3) Standard Pipe Unions. In order to facilitate the work and have each subject given proper attention, the subjects were divided between the three associations, the Master Car Builders' Association taking charge of the first subject, the American Railway Master Mechanics' Association the second subject, and the American Society of Mechanical Engineers the third subject.

The subjects assigned to the Master Car Builders' Association and the American Railway Master Mechanics' Association have already been reported upon to both associations and standards have been adopted in both associations as a result of the investigations of the committee.

The committee of the American Society of Mechanical Engineers, after considerable unavoidable delay, was finally organized, and after a careful consideration and study of the designs of all makers of unions, the committee has completed a design of commercial sizes of malleable pipe unions for wrought iron pipe from ⅛ in. to 4 ins., inclusive.

After the convention of 1901 the executive committee of this association requested Mr. E. M. Herr to present to this convention an individual paper on some agreeable subject, to which he acquiesced, suggesting that inasmuch as the committee of the American Society of Mechanical Engineers (of which he was chairman) had submitted its report on standard pipe unions, it would perhaps be timely to bring the subject to the attention of this association and also the American Railway Master Mechanics' Association, and at his request the former committees were revived to receive the report. Your committee has received from Mr. Herr a copy of the report to the American Society of Mechanical Engineers, and it is appended hereto as the principal part of its report. The matter has been carefully considered and your committee recommends that pipe unions ⅛ in. to 4 ins., inclusive, of the dimensions given in Table B, be referred to letter ballot for adoption as a standard of this association.

The following is taken from the report to the American Society of Mechanical Engineers by a committee of which Mr. Herr was chairman:

Gentlemen:—Your committee, appointed to consider the subject of securing uniformity in the threads of coupling unions for pipe, in joint conference with similar committees of the American Railway Master Mechanics' Association, and the Master Car Builders' Association, beg leave to report as follows:

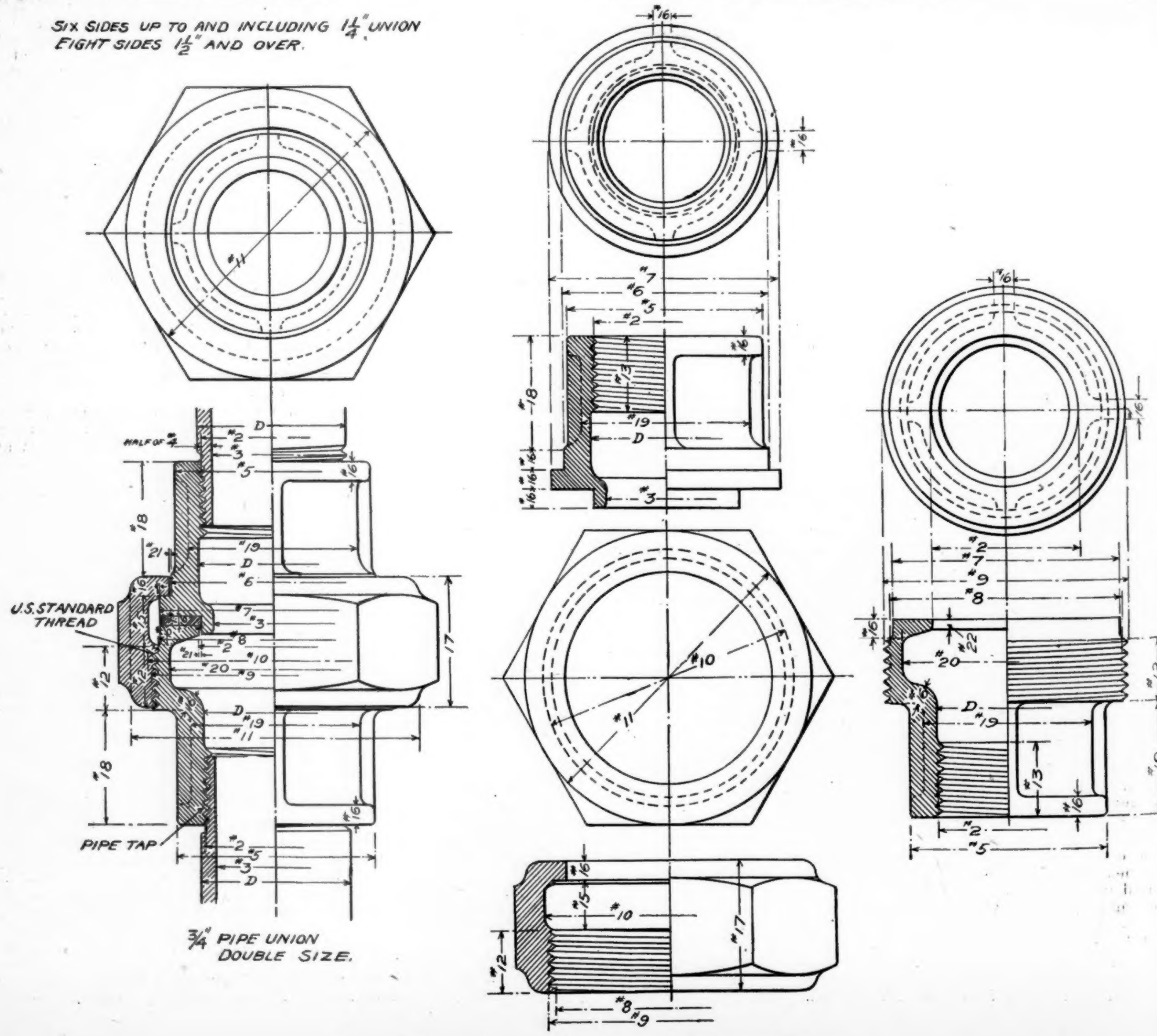
It was found that the committees of these associations were also considering two other matters, namely, Uniform Pipe Threads, and Standard Square Heads for Bolts; and desired your committee to proceed with the active consideration of the subject of Uniformity in the Threads of Coupling Unions for Pipe.

A careful examination of the dimensions of the threads in the unions made by each of the principal manufacturers of these fittings showed that there was absolutely no two alike and, further, that the other dimensions of the unions were so affected by the dimensions of the threads in the coupling nut that any successful attempt at uniformity in the threads must necessarily carry with it uniformity in so many of the other dimensions of the union itself that it would be necessary for this committee to take up not only the dimensions of the threads but of the entire coupling union.

A careful study of the design of all makes of unions, now commonly used, was then made for all sizes of pipe from ⅛ in. to 4 ins., inclusive. This investigation showed that no make of unions was sufficiently free from defects when critically examined in all sizes to warrant its adoption as a standard, even had it been considered desirable to do so; and your committee then decided to undertake the complete design of commercial sizes of malleable pipe unions for wrought iron pipe from ⅛ in. to 4 ins., inclusive, which we could indorse as a consistent design and submit as a proposed standard union. While this somewhat broadens the scope of your committee's work, it seemed the only practicable way to comply with our instructions.

The details of the design were worked out under the personal direction of Mr. Vogt, of the committee, who has prepared the data, drawings, and tables of dimensions accompanying this report, as follows:

Plate A shows a ¾-in. union, with all dimensions numbered for reference to the accompanying Table B.



General Dimensions of the Proposed Standard Union.

TABLE B. DIMENSIONS FOR PROPOSED STANDARD PIPE UNIONS.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
⅛ in...	.375	.270	.105	.59	.63	.78	.80	.85	.89	1.05	.26	¼	27	.2225	.08	.5625	½	.59	.615	.006	.05
¼ in...	.496	.364	.132	.76	.80	.96	.98	1.05	1.09	1.29	.33	5-16	18	.2625	.10	.6925	9-16	.76	.76	.006	.06
⅜ in...	.630	.494	.136	.90	.95	1.11	1.13	1.20	1.24	1.45	.34	⅜	18	.2825	.11	.7325	⅝	.90	.905	.006	.07
½ in...	.783	.623	.160	1.16	1.21	1.38	1.40	1.49	1.54	1.78	.40	7-16	14	.3025	.12	.8225	11-16	1.03	1.20	.006	.08
¾ in...	.992	.824	.168	1.38	1.43	1.61	1.63	1.72	1.77	2.02	.42	½	14	.3225	.13	.8725	¾	1.24	1.43	.007	.09
1 in...	1.246	1.048	.198	1.74	1.79	1.98	2.01	2.13	2.19	2.49	.49	9-16	11	.3625	.15	1.0025	13-16	1.565	1.76	.007	.10
1¼ in...	1.592	1.380	.212	2.12	2.18	2.37	2.40	2.52	2.58	2.90	.53	.6	11	.3825	.16	1.0725	.9	1.91	2.15	.007	.11
1½ in...	1.831	1.610	.221	2.40	2.46	2.66	2.69	2.81	2.87	3.20	.55	.7	11	.4025	.17	1.1225	1.0	2.18	2.40	.007	.13
2 in...	2.306	2.067	.239	2.89	2.95	3.16	3.19	3.31	3.38	3.74	.60	.8	11	.4225	.18	1.2025	1.1	2.66	2.90	.008	.14
2½ in...	2.775	2.468	.307	3.39	3.45	3.67	3.70	3.86	3.93	4.39	.77	.9	8	.5225	.23	1.5225	1.2	3.16	3.41	.008	.16
3 in...	3.401	3.067	.334	4.07	4.13	4.36	4.40	4.56	4.63	5.13	.84	1.0	8	.5625	.25	1.6525	1.3	3.81	4.08	.008	.18
3½ in...	3.901	3.548	.353	4.61	4.68	4.91	4.95	5.11	5.19	5.72	.88	1.1	8	.6025	.27	1.7525	1.4	4.31	4.63	.008	.20
4 in...	4.4	4.026	.374	5.15	5.22	5.47	5.51	5.67	5.75	6.31	.94	1.2	8	.6225	.28	1.8425	1.5	4.81	5.19	.008	.22

DESCRIPTION ACCOMPANYING TABLE OF MALLEABLE PIPE UNIONS.

NUMBERS AT THE HEAD OF THE COLUMNS ABOVE ARE THOSE GIVEN IN THE DIMENSION LINES ON PLATE A.

Column No. 1 in table represents the nominal diameter of pipe.

Column No. 2 represents diameter of pipe at one-half the height of full thread nearest solid section of pipe.

Column No. 3 represents the internal diameter of the pipe.

Column No. 4 represents the difference between Columns Nos. 2 and 3, and is equal to twice the thickness of metal in pipe, measured from inside line to one-half the height of thread, as specified before.

Column No. 5 represents the outside diameter of end of pipe union, and is taken as *No. 2 plus twice No. 4* plus an arbitrary increment.

Column No. 6 is equal to No. 5 plus an increment varying from .04 to .07 of an inch. This increment was allowed for the purpose of being able to slip the nut over swivel end of union.

Column No. 7 is No. 6 plus an amount varying between .15 and .25. This lip created is considerably in excess of what exists on present pipe unions, for the reason that we find the surface between the lip and the corresponding part of nut is often damaged, and the bearing surface, when the full strength of the man is used on the wrench, is sufficient. We assume that a man would pull about 30 pounds on a wrench, with a possibility of using less force on pipes of small diameters. For that reason we made a variation in the width of lip, which lip, theoretically, would be uniform for all sizes of pipe. The nut itself has been strengthened to prevent the lip from deflecting upward.

Column No. 8 is No. 7 plus an increment varying from .02 to .04 of an inch.

Column No. 9 is No. 8 plus twice the height of the thread.

Column No. 10 is No. 9 plus an increment varying between .04 and .08 of an inch.

Column No. 11 is No. 10 plus one and one-half times No. 4.

Column No. 12 is two and one-half times No. 4, and was figured especially for bearing surface, so that the thread would not wear away too rapidly when the nut is occasionally removed.

Column No. 13 has been assumed arbitrarily, but in all cases is greater than the length of full thread on standard pipe.

Column No. 14 represents the number of threads per inch in length of nut. This thread, we believe, should be United States standard form and not sharp thread.

Column No. 15 is taken arbitrarily, but is based on the probable requirements of manufacturers for tapping out the nut.

Column No. 16 is three-fourths of No. 4.

Column No. 17 represents the full height of nut, and is equal to No. 12 plus No. 15, plus No. 16.

Column No. 18 is the amount of projection outside of nut.

Column No. 19 is No. 2 plus No. 4, plus an arbitrary increment.

Column No. 20 is No. 7 less No. 16, with slight modifications.

Column No. 21 represents the clearance at several points, as indicated on print.

Column No. 22 is assumed arbitrarily.

Table B gives the dimensions of all sizes of unions from ⅛ in. to 4 ins., the figures at top of column referring to corresponding dimensions on Plate A. The description accompanying Table B explains this table, and where any radical departure is made from present practice, it is explained and the reasons given briefly.

It will be noted that all sizes from ½ in. to 4 ins. have the pipe and swivel ends paneled where the pipe wrench engages. This paneling is not put upon the smaller sizes on account of the increase in size of the nut and dependent parts necessitated by putting the ribs on the ends, nor is it considered at all necessary on these sizes.

The mark (S) on the side of the nut is suggested for a designating mark which could be secured by this society if it is deemed wise to pursue such a course. The committee recommends that this be copyrighted and the standard unions thus designated.

(Abstracts to be concluded.)

MASTER MECHANICS' ASSOCIATION.

THIRTY-FIFTH ANNUAL CONVENTION.

Abstracts of Reports.

HELPING ENGINES.

A Paper by F. F. Gaines,
Mechanical Engineer, Lehigh Valley Railroad.

The economy of using a helper under any given condition is determined by the total cost of transportation with and without the helper, of one ton, or some multiple of this unit, over the division. The conditions may be such as to require no calculation to demonstrate their economy. Or again, they may be such that only a very careful analysis of all conditions and factors is necessary to determine whether or not their use will be advantageous.

The leading factors in such a problem are: The volume of traffic; ruling grades, their length and rise; the time in which the traffic must be moved, due to competing lines; and the economical train length and tonnage, considered in connection with other divisions. The combinations of the variations of these factors furnish an almost infinite number of conditions. Each condition requires separate study and treatment, and excludes from consideration any general law applicable to all. The economy of using a helper, and its tractive power, if desirable to use one, is generally indicated by the average volume of traffic.

Each of the leading factors is subject to many modifications in connection with varying profiles. A few of the more common grade conditions are:

1. A comparatively level division, with the exception of a ruling grade of comparatively short length. 2. An undulating division, with heavy grades, and ruling grade only slightly in excess. 3. An undulating division, with a comparatively short, heavy ruling grade. 4. A division with a ruling grade of great length.

Assuming that the above conditions obtain in the direction of greatest volume of traffic, it is obvious that we may have the same or entirely different conditions of grade in the opposite directions. One of two conditions, as regards the size of train, may exist in a general way. In connection with other divisions, it may be desirable to have trains of a certain tonnage, for reasons that will be dealt with later; or, for various reasons, the largest train that can be handled by one engine is much less than can be handled satisfactorily by one train crew. Some of the conditions that might result in the latter are: Average size of recently built power owned; limiting weight of engines, due to bridges, rail, tunnel and other clearances; or, a standard road engine of insufficient power on the heavy grades. Where the economical tonnage, as regards handling by the train crew, or a standard train cannot be handled by the leading engine under the four general grade conditions, it would seem from a theoretical standpoint to call for a helping engine or engines.

The general conditions referred to divide into two general subclasses: First, where the length of grade is such that the helping engines are required only for a part of the division; and, second, where the helping engines are required for the whole division, or the greatest part of it. Cases one and three come under the first subdivision, and cases two and four under the second. Under some circumstances, case three may come under both; that is, double heading over the division, with a helper in addition on the heavy grade.

Where a helper is used only for a part of a division, and the helper is of the same power as the road engine, the tonnage handled over the division is doubled per train; the cost per ton-mile for fuel, wages of engineers and firemen, etc., is lessened in some cases, while the wages of one train crew have been saved in one direction, and if the road engines can handle the tonnage in the opposite direction alone, the wages of a train crew over a division and return have been saved. The light mileage of the helper is offset by the underloading of the two road engines that are necessary to handle the same tonnage without a helper, after passing over the ruling grade.

Where double heading in one or both directions over a division, with leader and helper of the same power, the wages of the second train crew are saved. Where the return tonnage can be handled by the leading engines, there is an additional economy, due to the difference in expense of the light mileage of helper, and the underloaded second engine that would otherwise be necessary.

In general, where a helper, either over a division or part of it, of equal or greater power than the leader, can be used in connection with normal loading, the economy is real and substantial. As the proportion of power to be furnished by a helper decreases, a point is reached where the economy curve changes direction and becomes negative.

There are certain conditions where the volume of traffic is light, and a certain number of trains are to be run, irrespective of their size, which make it more economical to have engines of sufficient power to handle the necessary trains under the grade conditions.

When the volume of traffic becomes so great that to handle the trains requires a more powerful engine than can be run, owing to the physical limitations of the right of way, from a theoretical standpoint a pusher or double heading becomes desirable.

On a trunk line, handling a large volume of through freight between its termini, it would seem that the maximum train that could be handled on the level, the limitations being due to length of train that can be handled with safety, should be its standard train. The size of the standard train may be further limited by the speed, as in fast freights, the lengths of sidings or physical limitations of the right of way, such as bridges, rail, ballast, etc., prohibiting the

use of a sufficiently powerful engine. Whatever the limiting factors, a standard train becomes desirable. With it yard work, delays and wear and tear due to shifting are eliminated at each division terminal it must pass from origin to destination. It will readily be seen that the time saved, where a train is brought in by one crew to a division terminal, and immediately taken out by another without shifting, is considerable. The expense of maintenance is also considerably decreased by such an arrangement, as it is safe to say that out of the total cost of repairs to rolling stock more than 50 per cent. of the cause is due to shifting in yards. Under a standard train system, it is desirable to have the leading engine of sufficient power to handle the train at the desired speed over the level, or comparatively level, divisions. The power of helping engines on the grades may then vary from a very small to a very large engine. Where no such system is in vogue, and each division handles its traffic to best advantage, independent of the size of train that may be delivered to it, or that it may turn over, the problem is simplified, in that it depends solely on the profiles of the different divisions, and each division can be treated separately.

From the record of a six months' performance of a number of engines of the same class on the Wilkesbarre mountain grade of the Wyoming Division of the L. V. R. R., the percentage of cost of the more important items, constituting the total direct cost per ton-mile, was found to be as follows:

	Per Cent.
Water supply	0.346
Waste and other supplies	1.167
All oils (lubricating and illuminating)	1.259
Roundhouse men (hostlers, wipers, etc.)	2.478
Interest and depreciation	12.315
Repairs	16.188
Fuel	16.366
Wages of engineers and firemen	21.386
Wages of train crew (exclusive of engine crew)	28.495
Total	100.000

It is apparent that with another engine of the same class as helper the tonnage would be doubled, the cost per ton-mile of all items remaining the same, with the exception of the wages of train crew, which would be decreased 50 per cent. As the cost of this item per ton-mile would be reduced by 50 per cent., and as it is about 28 per cent. of the total cost, the saving would be 14 per cent. on the double tonnage, or 28 per cent. It is also evident that an engine of less power would effect a less saving, and one of greater power a greater saving. These figures would vary under different conditions, but they indicate approximately the proportions of the different items constituting the total direct cost, and show that the direct economy is largely due to cutting down the cost of wages of train crew per ton-mile. There is also an indeterminate saving where helpers are used, due to the fewer number of trains. Where the volume of traffic is great, and must be handled on a single track, or at least two tracks, in connection with a number of passenger trains, the indirect saving is no inconsiderable item. In some cases a large volume of traffic may originate at or near the foot of a heavy grade; under these conditions it is sometimes advisable to make up the trains at the summit, and handle the tonnage on the grade entirely by helpers, or all except the amount in some cases handled by the road engine when on the way to the summit to take out a train. Obviously, the more powerful the helpers, the greater the economy until the limiting size of engine is reached.

There are three leading factors which largely determine the limiting size:

1. Weight that can be carried by rail and bridges.
2. Clearances, such as overhead bridges, tunnels, etc.
3. Construction of rolling stock.

There is also a point reached where the coal consumption per hour becomes so great that one or more additional firemen are necessary. Until such time as all cars have very much stronger underframes and draft gear than the average car of the present day, an engine with a tractive power of about 50,000 lbs. would seem to be near the economical limit.

An ordinary road engine, unless specially designed for such service, should not be used as the second engine in double heading, as, in addition to its own power, the frames and draft gear have to transmit the power of the leading engine. Conversely, an engine that is to be used for double heading or pushing should be designed with the service intended for it in view. As on heavy grades the maximum power is exerted at slow speeds, all parts should be extra strong, such as frames, rods, axles, crank pins, etc. The wearing parts should have liberal bearing surfaces, and provision for ample lubrication. Tenders of large coal and water capacity should be provided so as to cut out all or as many stops as possible on grade, as the time lost and damages to cars in starting are considerable. Where the grade is comparatively long it is doubtful economy to use a small diameter of driving wheel, on account of the greater power. It would seem a better policy to use a size of wheel that would allow the light engine to make good time down the grade without heating bearings or shaking the machinery to pieces, and to provide for the necessary power in the steam pressure and the size of cylinders.

No class of service makes heavier demands on power than helping service, and time spent in careful design so as to produce satisfactory results will be amply repaid by the decreased maintenance charge. In designing, special care should be given to accessibility, both on the road and in repairs. Helping engines are frequently located where they can only receive roundhouse repairs between general overhaulings, so that the desirability of a design to which running repairs can be made cheaply and quickly is very essential.

PRESENT IMPROVEMENTS IN BOILER DESIGN AND BEST PROPORTIONS OF HEATING AND GRATE SURFACES, FOR DIFFERENT KINDS OF COAL.

Committee—George W. West, T. W. Demarest, H. D. Taylor, John Player.

Your committee, after a preliminary study of the subject, decided that it was more comprehensive and of greater scope than its limited time would allow to take up and treat thoroughly. For this reason it was decided to deal with that portion of it that concerns heating and grate surface. The remaining portion, dealing with improvements in design, is of sufficient magnitude to form an independent paper. As such a paper would be valuable, the committee recommends that it be considered as a subject for the next convention and a new committee appointed to investigate and report on it.

Knowing from past experience that it is difficult to obtain from the members full and prompt replies to a circular of inquiry, the data for this paper was obtained from the technical press. It consists of the engines illustrated by the different railroad papers during the years 1900, 1901, and the first four months of 1902. As only new types of engines, representing the most advanced ideas of buyer and builder, are so treated, it will be seen that the data is reliable, full, and covers the most recent practice. In addition to the engines obtained in this manner, a few engines with boilers and fireboxes for burning anthracite coal, the performances of which are known by the committee, have been added.

The ratios given by the committee, in its report to the association at the convention of 1897, do not cover the recent increase in grate surface, and the basis of comparison of the previous ratios determined for the association contains only one factor—the working force. This factor alone, without considering speed, with which the problem is so intimately connected, is of very little real value for accurately determining the correct proportions of a boiler. If, however, we combine the working force with the speed or rate of working, we then have the power. As the boiler must furnish a certain amount of power, or an amount of energy sufficient to perform a certain amount of work in a given time, it becomes apparent at once that the real basis from which the amount of heating surface should be computed is the maximum power, and that the total heating surface of any boiler is the product of a constant times the maximum power demanded by the service. If we take for the unit of power a horse-power, the formula for heating surface becomes of the following form:

Total heating surface = (constant) × maximum horse-power.

The formula for horse-power is:

$$\text{H. P.} = \frac{P\,L\,A\,N}{33000} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1.)$$

Where P = The mean effective pressure or Pm;
L = The length of stroke (feet) or S/12;
A = The area of cylinder, or $\frac{1}{4}\pi d^2$;
and N = The number of strokes or 2 × revolutions per minute for one side, or 4 × (R. P. M.) as a total.

$$\text{Also (R. P. M.)} = \frac{\text{Miles per hour} \times 5280}{60 \times \text{circumference of drivers (feet)}},$$

where the circumference of drivers $= \pi$ D/12.

Substituting the above values of the factors in equation (1), it becomes:

$$\text{H. P.} = \frac{Pm \times S/12 \times \frac{1}{4}\pi d^2 \times 4\ (\text{M. P. H.}) \times 5280}{33000 \times 60 \times \pi\ D/12};$$

$$\text{simplifying:}\quad \text{H. P.} = \frac{Pm\ d^2\ S \times (\text{M. P. H.})}{375 \times D} \quad \ldots\ldots\ldots (2.)$$

The English rule for the maximum sustained speed of an engine is:

10 × diameter of drivers (in feet) = M. P. H.;

but for the sake of simplicity, if we take the maximum sustained speed as equal to as many M. P. H. as there are inches in the diameter of the drivers, we have for the sustained speed:

M. P. H. = D, and equation (2) becomes:

$$\text{H. P.} = \frac{Pm\ d^2\ S}{375} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.)$$

Where the M. P. H. equals the diameter of drivers in inches, the revolutions per minute become constant, or R. P. M. = 336. The Baldwin Locomotive Works show, in their handbook (page 27), that for 336 revolutions per minute the mean effective pressure is 30 per cent. of the initial pressure, and that the initial pressure is about 76 per cent. of the boiler pressure. This makes the mean effective pressure

$$Pm = .3 \times .76 \times (\text{boiler pressure})$$
$$= .228 \text{ or } 23\ \% \times (\text{boiler pressure—}P).$$

Substituting this value for Pm in (3) we have:

$$\text{H. P.} = \frac{.23\ P\ d^2\ S}{375} = \frac{P\ d^2\ S}{1630},$$

where P = Boiler pressure;
d^2 = (diameter of cylinder in inches)^2;
and S = Stroke (in inches).

The above, while applying to simple engines, does not apply to compounds, nor is there any available data to show the average mean effective pressure of a compound at high speeds. If, however, we equate the gross tractive power of a compound engine to the gross tractive power of a similar simple engine, and then solve for cylinder diameter, we have the size of a simple cylinder having

SUMMARY OF RESULTS OBTAINED.

KIND OF ENGINE.		Simple Passenger	Compound Passenger	Simple Freight	Compound Freight.
TOTAL HEATING SURFACE. / Max. Ind. Horse-power, or number of feet of Heating Surface per I. H. P.	Maximum	2.39	2.58	2.30	2.15
	Mean	2.00	2.13	1.71	1.80
	Minimum	1.72	1.70	1.48	1.58
TOTAL HEATING SURFACE. / Grate Area, or number of feet of Heating Surface per square foot of Grate Area	Very free-burning bituminous	65 to 90	75 to 95	70 to 85	65 to 85
	Average bituminous coal	50 " 65	60 " 75	45 " 70	50 " 65
	Slow-burning bituminous or mixture of anthracite and bituminous	40 " 50	35 " 60	35 " 45	45 " 50
	Slack bituminous, mixtures of anthracite and bituminous, and free-burning anthracite	35 " 40	30 " 35	30 " 35	40 " 45
	Very low grade bituminous, lignite, mixtures of anthracite and bituminous and slow-burning anthracite	28 " 35	24 " 30	25 " 30	30 " 40
TUBE HEATING SURFACE. / Fire-Box Heating Surface, or number of square feet of Tube Heating Surface per square foot of Fire-Box Heating Surface	Maximum	16.67	18.56	18.50	17.56
	Mean	13.42	13.42	12.75	13.58
	Minimum	10.25	10.09	9.04	11.50
TOTAL WEIGHT OF ENGINE. / Max. Ind. Horse-power, or weight (in lbs.) per I. H. P.	Maximum	145.00	165.00	142.50	127.50
	Mean	127.00	135.00	115.50	113.25
	Minimum	108.00	111.00	101.25	102.25

the same power as the compound. This was done for the compound engines, and the size of the equivalent simple cylinders is shown on the data sheets. It is admitted that this method is open to criticism, yet as the results are to be used for comparative purposes, it provides, in the absence of more authentic information, a basis for comparison, and indicates limits which may be of service in future designing. As the horse-power formula has as its basis the results of a large number of indicator cards, it might be appropriate to speak of horse-power determined in that manner as "indicated horse-power" (I. H. P.), and it will be so referred to in this report.

The important relations in boiler design are those between the power and the total heating surface, and between the total heating surface and the grate area. These relations for the engines in question have been determined, and also some additional ratios that are of no special value, except as of interest in making comparisons. These ratios were all tabulated on data sheets, and the relations in all cases determined graphically. The maximum, mean and minimum ratios of total heating surface to maximum I. H. P. were determined for the various examples as follows: Using as ordinates and abscissæ the values of these two factors, a point was determined graphically upon a diagram for each engine under consideration. A line drawn approximately through the middle of these points is an average or mean location of all points. If in the equation of a straight line, $y = ax + b$, we substitute the ordinate and abscissa of any point on the line, we have an equation where, if any other ordinate be known, its abscissa can be determined. After locating the mean line, the extreme lines representing the maximum and minimum limits were drawn and their equations determined. All ratios have been determined separately for

(*a*) Simple passenger engines,
(*b*) Compound passenger engines,
(*c*) Simple freight engines, and
(*d*) Compound freight engines.

Where the ratios deal with grate areas, these divisions have been further subdivided so as to cover both anthracite and bituminous coal. The number of engines constituting the data from which the grate-area proportions for anthracite coal were determined is small—in one case only three engines. Each engine, however, represents a class in which there are a large number of individual engines, and it is known that their performance is satisfactory.

RESULTS:

For the ratio $\dfrac{\text{Total heating surface}}{\text{Max. Ind. horse power}}$, we have:

Kind of Engines	Simple Passenger.	Compound Passenger.	Simple Freight.	Compound Freight.
Maximum ratio — square feet of heating surface per horse power	2.39	2.58	2.30	2.15
Mean ratio—square feet of heating surface per I. H. P.	2.00	2.13	1.71	1.80
Minimum ratio — square feet of heating surface per I. H. P.	1.72	1.70	1.48	1.58

The compound passenger engines show the greatest variation between extremes, and the compound freights the least, while the compound engines have in each service a higher mean ratio than the simple engines.

For the ratios $\dfrac{\text{Total heating surface}}{\text{Grate area}}$, we have:

Kind of Fuel	Bituminous Coal.			
Kind of Engines	Simple Passenger.	Compound Passenger.	Simple Freight.	Compound Freight.
$\dfrac{T\ H\ S}{G\ A}$, or square feet of heating surface per square foot of grate—				
Maximum ratio	90.50	94.50	87.00	87.50
Mean ratio	66.67	75.00	71.50	66.67
Minimum ratio	51.50	62.91	47.00	51.25

Kind of Fuel	Anthracite Coal.			
Kind of Engines	Simple Passenger.	Compound Passenger.	Simple Freight.	Compound Freight.
$\dfrac{T\ H\ S}{G\ A}$, or square feet of heating surface per square foot of grate—				
Maximum ratio	40.38	35.38	37.38	45.63
Mean ratio	33.50	32.75	31.63	39.25
Minimum ratio	27.75	23.63	27.88	30.63

In the above table, under bituminous coal, the ratios found cover grate areas for burning nearly all grades of this coal. The maximum ratio is probably only suitable for extremely free burning qualities, and should not be exceeded. The mean ratio is probably suitable for the average quality of bituminous fuel, while the minimum limit is suitable for the poorer qualities. While division is made between anthracite and bituminous coal on the diagrams and tables, in reality no such division exists, the maximum ratios under the latter head being suitable for slack bituminous coal, and in fact one lot of engines plotted under this head burns bituminous coal. The higher ratios under anthracite coal are really only suitable for low grades of bituminous coals or a mixture of ordinary bituminous coal with fine anthracite. The mean ratios under anthracite are suitable for good lump anthracite, and mixtures of bituminous and fine anthracite, while the minimum ratios are none too small for ordinary lump anthracite, mixture of fine anthracite and bituminous, and fine anthracite alone. It is not possible to define absolutely the necessary amounts of grate surface for the varying qualities of fuel that are in use, but the ratios show limiting practices and to a certain extent should be useful, as indicating for average bituminous and anthracite coal the proportions used in most recent constructions.

The ratio between the tube heating surface and the firebox heating surface was also derived. This ratio is of no particular value, as the grate area controls it to a large extent, but may prove of interest, as the graphical analysis shows the relation between them to follow a fairly defined law. The ratios as derived are:

Kind of Engine	Simple Passenger.	Compound Passenger.	Simple Freight.	Compound Freight.
Maximum ratio — square feet of tube heating surface per square foot of firebox heating surface.	16.67	18.56	18.50	17.56
Mean ratio—square feet of tube heating surface per square foot of firebox heating surface....	13.42	13.42	12.75	13.58
Minimum ratio — square feet of tube heating surface per square foot of firebox heating surface.	10.25	10.09	9.04	11.50

The relations between power and weight, which are to a certain extent an index to the probable weight of a new engine after the power has been decided, were also determined as follows:

Kind of Engine	Simple Passenger.	Compound Passenger.	Simple Freight.	Compound Freight.
Maximum ratio — weight in lbs. per I. H. P.....	145.0	165.0	142.5	127.50
Mean ratio — weight in lbs. per I. H. P........	127.0	135.0	115.5	113.25
Minimum ratio—weight in lbs. per I. H. P.......	108.0	111.0	101.25	102.25

A summarizing table of all ratios derived will be found below, including in the second part the interpretation of the grate area in relation to the fuel as outlined heretofore.

The committee recommends, in connection with this report, that the association adopt as a standard:

(1) For comparisons of heating surface, the relation between the indicated horse-power and total heating surface, the formula for I. H. P. being:

$$\text{I. H. P.} = \frac{P\,d^2\,S}{1630}$$

Where P = Boiler pressure.
d^2 = (Diameter of cylinder in inches)^2.
S = Stroke in inches.

(2) For comparisons of weight, the relation between the indicated horse-power and the total weight of engine.

In case of the adoption of these methods by the association, it is further recommended that the secretary of the association be instructed to communicate with the technical press and request their co-operation in the use of these methods of comparison.

ELECTRIC DRIVING FOR SHOPS.

An Individual Paper by C. A. Seley.

This mode of transmission of power has, since the committee report on this subject presented to this association in 1900, undergone considerable development, and shows such advances and new opportunities that it may be interesting to know what were the consideration and ruling factors in the design of one specific example of installation. We cannot, as a rule, have new shops to lay out exactly to meet our economic needs in railway equipment building and repair work, but have to build on and add to an old establishment until often the original plan is lost. Transmission of material and movement of partially completed and of finished product are of much greater importance than transmission of power, and this is too often lost sight of in railway shop arrangement. In many lines of manufacturing which employ metal and woodworking tools the most successful managers are those who have kept up with the latest developments of modern tools, automatic machinery, electric cranes, pneumatic hoists and tools, and other means of multiplying production, and, above all, economy of handling.

Electric driving is of special value in old establishments that have outgrown their original plan, or those which could be enlarged or rearranged in reference to economic movement of material, provided a satisfactory solution of the power problem was offered. In many old shops additions have been put on and lineshafts unduly lengthened, an engine put in here and a boiler there. The cost of these auxiliaries is not so great, but if we look into the cost of daily maintenance, the extra attendance, the handling of fuel when distributed to a number of points, handling of ashes, the low efficiency of small isolated plants, the general waste of supplies when drawn for a number of plants scattered here and there, and carefully analyze the cost of each of these items, it will often be found that the fuel charge is by no means the greater portion of the cost.

An example of an old shop very largely added to, and employing auxiliary steam and power in several departments, is the Roanoke shops of the Norfolk & Western Railway Company. These shops were built in the early 80's, on a liberal scale, and fortunately were laid out so that additions consistent with the general plan could be made. By June, 1901, the work required at Roanoke had developed to an amount that important additional buildings were planned, necessitating also a general revision of the power transmission which should also check the waste due to the several plants. An unfortunate delay in the delivery of some of the machinery has, however, hindered the construction and starting up of the plant, so that some data is not available at the time of writing.

In order to give an idea of the size of the Roanoke shops, it may be stated that they take care of the medium and heavy repairs of nearly 500 locomotives, mainly of the consolidation type, build complete one 21 by 30 consolidation engine per month, and of cars about 1,000 per year, and also the freight repair work of 1,600 freight cars per month, the entire passenger equipment, heavy repairs and considerable building of new passenger equipment, miscellaneous road work, switches, water station and coal pier work, etc., of a 1,600-mile road, including all foundry work for same. The general plan of the shops is shown in the accompanying engraving.

There were two principal power plants, one in the machine shop, which furnished power to a number of shops, and one in the planing mill, whose boilers furnished steam for various purposes. Besides these, there were five auxiliary plants of boilers or engines, or both, making a sum total of 880 nominal horse-power of boilers and 775 nominal horse-power of engines for shop power, heating and lighting, the latter service extending beyond the shop's inclosure and furnishing all night and some day lighting for lighting the general offices, hotel, depots and yards.

Thus a varied, scattered power service had been built up, and to take its place the new plan must take into consideration the concentration so far as possible into a central power station of such an amount of power as would do away with all auxiliaries, and the change had to be made without interference with the operation of the shops or lighting plant. A careful study of the situation developed the following plan: To provide a new boiler plant capable of developing steam for all power needed, except only such as could easily and with certainty be furnished from refuse from the planing mill with practically no extra cost of handling, the object being to thus utilize a means of burning refuse.

In such an electric installation the center of electrical distribution is an important point to find, and the generating plant should be placed near thereto. In shop plants this is not always the ruling factor, as it may pay to use a little more copper and place the plant where other considerations are of more importance. In this case the utilization of a large brick stack of sufficient capacity and the location of an elevated trestle for directly dumping hopper cars of coal indicated the location of the new boiler house, which was planned for the immediate installation of 600 nominal horsepower of boilers and reserve for 400 horse-power additional. These boilers are in 200 horse-power units, it being believed that smaller units do not give a like economy and that it would not be wise to have less than a two-thirds capacity to fall back on in case of the failure of any one boiler. The boilers have been installed and connected to the old system of steam piping, and have been operating for some months in a very satisfactory manner, and a considerable economy of fuel and maintenance has been secured thereby.

The direct-current system of electric transmission of power and lighting was adopted, using two-wire, 220-volt current for motors and three-wire system for lights. This was determined upon after visiting a large number of plants. Instead of preparing a set of specifications requiring a definite arrangement of the electrical machinery, it was thought best to issue an invitation to the electrical companies to tender on such forms of apparatus as in their opinion would best suit our needs, these needs being fully set forth for their information. The instructions relative to the general lay-out read as follows: "There are to be three generators, each direct driven by a compound, non-condensing engine. Inasmuch as two voltages are desired, namely, 110-volt, three-wire system for lighting, and 220 volts for power circuits, the arrangement and design of these generators may be proposed in more than one form, to permit delivery of current from the switchboard of either power or lighting voltage from any combination of the generators." A schedule of the power and lights probably required was then given, covering the twenty-four hours. The instructions then proceed: "All generators must be of the latest and most improved type. They must be guaranteed by their makers to develop the electrical energy specified, and the guarantee should state the electrical efficiency and also the limit of heating with the rated load."

The system of shop lighting had been a series, constant-current, double-carbon, open-arc lamp system for general illumination, and 110-volt incandescent lamp system on alternating circuits. The new system puts the power and lights on the same current, using more than one unit for generating, and thereby lessening the probability of a breakdown affecting the continuity of service. Direct-current machinery was chosen on account of its applicability to all the classes of service required, and for three principal reasons: First, for use in crane service, as being best adapted to that work; second, by reason of the slower speeds of direct-current motors, so that they are more readily belted direct to line shafts and machines without the use of intermediate countershafting; third, although alternating-current motors are very enticing, on account of their simplicity and ease of repair, they are, however, far more expensive per horse-power than direct-current motors, and great care has to be taken in wiring for the alternating-current systems to avoid trouble and losses from induction and cross currents. No trouble of this kind is experienced with the direct current if care is taken to properly proportion the wires for their load and the ordinary precautions in regard to insulation are followed.

The accompanying plan of the work shows that the power station is by no means the center of distribution, the greatest radius being about 2,000 ft., and it required a 700,000 c. m. (.84-in. diameter) cable to transmit the power necessary at the mill. The investment in such a cable, however, was far less than it would have been to install the power house at an intermediate point so as to reduce this radius and the weight of the copper required.

The bidders were requested to fulfill the following conditions in their tenders on the switchboard: "The switchboard to be of marble, provided with one ammeter and one voltmeter for each generator; two recording wattmeters (one for each side of the three-wire circuits; one recording wattmeter for power circuits. To have also automatic cut-outs for guarding against overloads; lightning arresters, and the necessary fuses. Triple bus-bars are to be provided for light circuits and double bars for power circuits, and suitable switches are to be provided to throw the current from any generator to either the lighting or power circuits, and in addition to these there should be a main switch for throwing the two sets of bus-bars together. Contractors are requested to furnish a design of switchboard embodying these features, and in addition such feeder panels and switches as seem necessary to operate the plant,

taking into consideration the plan of the works and the distribution of power and lights as stated.

"It is desired that the switchboard be of neat design, with all instruments, switches and other attachments first class in every respect. It is desired to incur no unnecessary expense in elaboration, but to provide every facility for convenient operation, safety and accurate electrical measurements and records. The wiring between the generators and switchboards to be of heavy copper, braided, rubber-covered cable run below the floor in conduits."

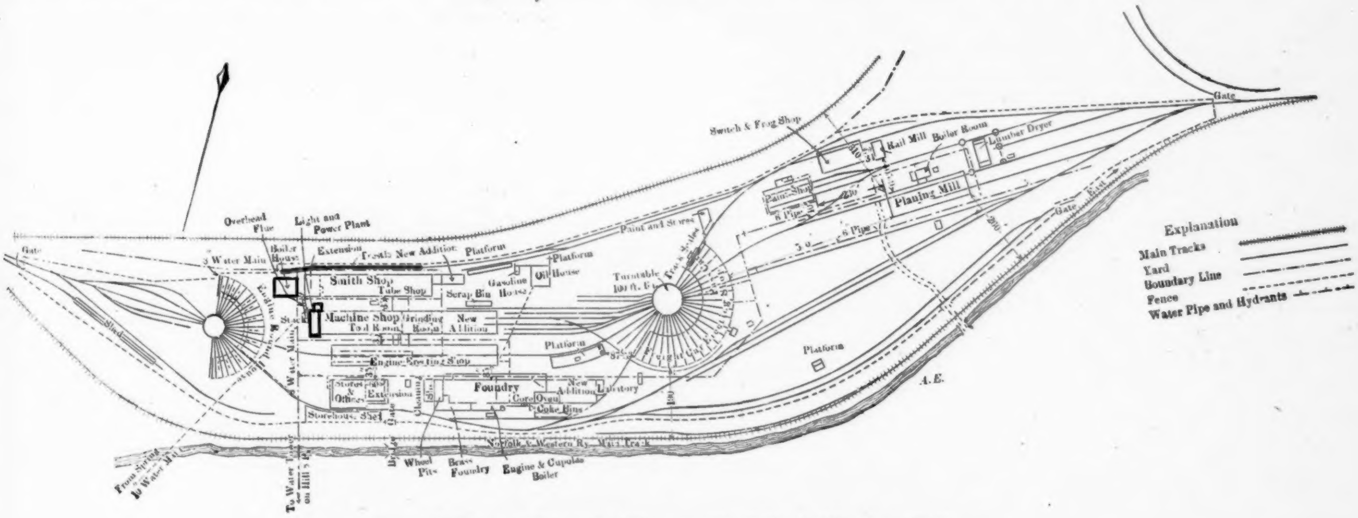
A complete plan of the works and yards and the probable amounts of light and power for each location were furnished bidders upon which to base their recommendations and proposals. The system finally adopted comprised three generators, one 75-k.w. and two of 160 k.w each, the smaller unit being approximately 100 horse-power and the larger ones something over 200 horse-power each, so that it may be seen that by combinations of the generators, 100, 200, 300, 400 or 500 horse-power may be transmitted to the board. This is believed to be good steam engineering, as it affords an opportunity to work the engines closely within their most economical range of steam using. The three-wire system of lighting generally requires two 40-volt generators, to be worked in series, but in this plant, for considerations of simplicity, first cost and general convenience, and for the further reason that the plant is primarily a power plant, the generators were arranged with a view to all these considerations to operate direct to the board at 220 volts, which is also the proper voltage for the outside wires of the three-wire system. The means of maintaining proper current balance between the two sides of the three-wire lighting system was then provided for by using a motor-generator balancer set of 10-k.w. capacity, which machine has its controlling switches on a panel of the switchboard and in a simple manner maintains the balance of the two sides, correcting any inequality of current due to one side being more heavily loaded than the other. Care having been taken in the distribution of the lights on the circuits, the balancer has little to do, and is a simple and effective device.

General inside illumination is provided for by the use of 110-volt inclosed arc lamps on the incandescent lamp circuit, having opalescent single globes and sheet-iron shades painted white. This style of arc lamp is believed to be best suited for shop lighting, as against the use of double-glass globes with no shades, as the shades distribute downward a portion of the light that would be otherwise wasted upward and do not interfere with the lateral distribution of the light.

The question how far individual motor driving should be considered for machines is an interesting one, but it is the belief of the writer that it is not necessary or advisable to consider anything but group driving in the average railroad shop. There is one shop, for instance, that has been considerably exploited by the consulting electrical engineer who laid it out, which is a shining example of the extreme in individual motor-driving, there being 94 machines, excluding cranes, turntables, etc., driven by 68 motors; the machine shop shows 42 machines driven by 29 motors. The motors are of varying sizes, and the arrangement is such that if another machine were to be put in, a motor for it would be required. In the Norfolk & Western machine shop there are 133 machines, which will be group-driven by six motors, aggregating not over 100 horse-power. A machine may be added to any group without seriously overloading the motor, and, as there are several groups, we may add a number of machines without change of motors. The additional load would be shown only at the switchboard, but by reason of the group system it would add but a small amount to any one motor.

The reasoning in favor of group-driving of railway shop machinery is as follows: One machine requiring one horse-power may be taken as a unit; individually motor-driven, this machine would require a one horse-power motor attached to operate it, no matter how much or little it runs, and average machine tools are idle or running light at least half the time, for work or tool adjustment, while two or three such tools grouped would not require their full multiple of the unit power. The full value of grouped driving will be reached, first, when the number of machines in the group will enable the use of a motor of sufficient size for a near approach to good electrical efficiency, which is not possible with small motors; and, second, when the number of machines is such that their proportions of idle time may be so distributed over them as to be practically continuous and effect a proportionate reduction in the power needed in the motor. For example, if one unit takes one horse-power and is idle one-half the time, two such units can be driven by a one horse-power motor, provided the machines are run alternately, but if both are operated together the motor will be subjected to 100 per cent. overload. If we take 10 such units, however, and use a five horse-power motor, the chances are about even that the motor will be driven to its rating, and they are infinitely small as to its ever getting 100 per cent. overload. There is no argument against individual motor driving in case the machines to be driven are large enough, or their isolation is necessary to facilitate movement of material, but we are considering average railway shop machinery, and in most cases old machinery already group-driven from shafting.

The extremist in electric driving does not like to use shafting, but as against an almost 100 per cent. increase of total motor capacity required, the low electrical efficiency of small motors and also the high cost per horse-power for small motors, as compared with those of moderate size and power, a reasonable length of shafting will in the end prove the best investment for our class of work. In a wood-planing mill the case is somewhat different. The power required is so much greater for heavy planers, and other continuously operated machines, that individual driving may be attempted, but even here it may profitably be limited. Saws, shapers, jointers, mortisers, tenoners, band saws, borers, all intermittently operated machines, can be successfully grouped and driven with a fraction of the power required for individual driving.



Ground Plan of Roanoke Shops.—Norfolk & Western Railway.

The mill was driven with a large engine. An indicator test showed the average power required, including all friction, to be 160 horse-power, although for short intervals it ran a little over 200 horse-power. It was believed that, by the elimination of the engine friction, the heavy transmission belts, and certain unused lengths of shafting, that 125 horse-power of motors would operate the mill, but it was decided that it would be wise, however, to overrun the calculated power at the heavy end of the shop somewhat and 140 horse-power of motors were ordered.

Other departments that are to be motor-driven in groups are the smith shop, bolt and forging machinery; the forge blowers, together with the flue-shop machinery; the bolt and nut-cutting machinery, together with the smith shop punching and shearing machinery; boiler-shop machinery; the foundry rattlers, grinders and drilling machinery in two groups, and the foundry cupola blowers are also to be driven with a motor with rheostatic control for varying the speed according to the need for blast. In all, twenty-three motors were ordered, as follows: Three 7-5 horse-power, five 10 horse-power, three 15 horse-power, ten 20 horse-power, one 30 horse-power, one 35 horse-power, aggregating 382.5 horse-power. It will be noted that the 20 horse-power motor is ordered in a larger quantity than any other size, it being intended that this should be the standard motor, so far as possible. All motors are of the regular commercial type, standard with the manufacturers.

The above described motors are in all cases to be belted direct to line shafting, instead of directly attached on the end of line shafting, as at the General Electric Company's shops at Schenectady. Back-geared motors directly attached were not used, as the gearing is very noisy, and this plant does not employ strictly standard motors. At the Baldwin Locomotive Works, where both individual and grouped driving are very extensively used, belts are used to the greatest possible extent, and in many cases with such short belt centers as to be surprising that good results could be obtained. It was explained that this method was very satisfactory, and that after a belt was taken up a few times in most cases it would run thereafter almost indefinitely, and, if it did fail, its replacement was much easier, cheaper and speedier than to repair broken gearing.

On the other hand, many shops employ gear connections be-

tween their motors and machines, especially the modern heavy machinery, much of which is now built to be directly driven. Where the gearing can be covered and protected it may do very well, but wear is inevitable and gear breakages are expensive and at times exceedingly inconvenient. There is a very desirable flexibility in a belt connection, and if there should be a failure of the motor an extra one can be readily installed if standard types are employed. Some of the electrical companies have developed systems of multiple voltage, which, in connection with double or triple gearing, give a large range of adjustment of cutting speed of tools individually driven, enabling maximum output after proper speed has been determined by experiment. These systems involve the use of considerable gearing, additional wiring and a generating set arranged with reference to the number of the voltages desired. Some of our friends who have installed multiple voltage may be able to enlighten us as to its advantages, but, as the writer does not favor individual driving as a rule, multiple voltage was not considered in connection with the plant under discussion.

(*Abstracts to be concluded.*)

The Handy Car Equipment Company has, in addition to its other specialties, secured control of a patented swinging pilot coupler, to be known as the Handy Horizontally Swinging Pilot Coupler. The office of the company is in the Old Colony Building, Chicago.

EXHIBITORS AT THE SARATOGA CONVENTION.

American Balance Valve Company, Jersey Shore, Pa. American balanced slide valves.
American Brake Shoe & Foundry Company, New York and Chicago. Railway brake shoes and miscellaneous iron and steel castings.
American Locomotive Co., New York. Locomotives.
American Steel Foundry Company, St. Louis, Mo. Models of steel trucks and bolsters.
American Watchman's Time Detector Company, The, New York, N. Y.
Ashton Valve Company, Boston, Mass.
Aurora Metal Company, Aurora, Ill.
Ajax Metal Company, Philadelphia, Pa.
Alexander Car Replacer Manufacturing Company, Scranton, Pa.
American Locomotive Sander Company, Philadelphia, Pa.
Baker Manufacturing Company, Pittsburg, Pa.
Baltimore Ball Bearing Company, Baltimore, Md. Norwood ball-bearing center and side bearings.
Boston Belting Company, The. Samples of air brake, steam and water hose.
Brill Company, J. G., Philadelphia, Pa. Car trucks.
Buckeye Malleable Iron & Coupler Company, Columbus, O. The Major automatic coupler.
Bullock Electric Manufacturing Company, Cincinnati, O., 28-in. Lodge & Shipley lathes driven by type "N" Bullock motor. Speed controlled by Bullock multiple voltage system.
Chicago Pneumatic Tool Company, Chicago, Ill. Full line of pneumatic hammers and drills and other pneumatic tools.
Chicago Railway Equipment Company, Chicago, Ill. National Hollow, Kewanee, Diamond and Central brake, Sterlingworth, Monarch solid and "Ninety-Six" Automatic Frictionless Side Bearings, and a specially adapted brake beam for high-speed brake service.
Commonwealth Steel Company, St. Louis, Mo. Models of trucks and bolsters.
Consolidated Car Heating Company, Albany, N. Y. Steam heating apparatus, steam couplers, steam traps, etc.
Consolidated Railway Electric Lighting & Equipment Company, New York, N. Y. Electric car-lighting apparatus and fixtures. The private Pullman car "Columbia," used by Prince Henry on his recent tour in the United States, equipped with Consolidated "Axle Light" system of electric lights and fans.
Crane Company, The, Chicago, Ill. The new Crane locomotive muffler pop safety valve, gun metal globe and angle valves and blow-off valves for high steam pressure.
Crosby Steam Gage & Valve Company, Boston, Mass.
Curtain Supply Company, Chicago, Ill.
Damascus Brake Beam Company, St. Louis, Mo.
Damascus Bronze Company, Pittsburg, Pa.
Davis Pressed Steel Company, Wilmington, Del. Davis solid truss brake beams.
Dayton Malleable Iron Company, Dayton, O. Dayton draft gear, Dayton patent car door fastener, lubricating center plate.
Joseph Dixon Crucible Company, Jersey City, N. J. Preservative paints.
Drake & Wiers, Cleveland, O. Car roofs and universal drafting machine.
Economy Car Heating Company, Portland, Me.
Edwards Company, The O. M., Syracuse, N. Y. Window models showing four designs of windows comprising recent improvements, four models of extension platform trap doors for wide vestibules and open platforms for railway coaches.
Edwards Railroad Electric Light Company, Cincinnati, O. Half section model of electric headlight.
Excelsior Car Roof Company, St. Louis, Mo.
Falls Hollow Staybolt Company, Cuyahoga Falls, O.
Fay & Egan Company, J. A., Cincinnati, O.
General Electric Company, Schenectady, N. Y. Eight horse-power motor driving a 48-in. portable Newton slotter; two Chapman valves.
Gold Car Heating Company, New York and Chicago. Car heating apparatus, duplex coil system and straight steam operated under steam; also various parts of apparatus shown separately.
Goodrich, B. F., Company, Akron, O. Rubber hose, packing, belting, locomotive tender hose, rubber tiling.
Gould Car Coupler Company, New York, N. Y. Showing passenger and freight slack adjuster, improved M. C. B. journal boxes, improved malleable draft rigging for freight equipment, with spring buffer blocks; improved M. C. B. coupler for 100,000-lb. car and improved locomotive tender coupler for heavy equipment.
Hammett, H. G., Troy, N. Y. Richardson and Allen Richardson balanced slide valves, oil cups, "Sansom" bell ringer, link grinders, etc.
Handy Car Equipment Company, Chicago, Ill. Full size Snow locomotive and car replacers, American Dust Guards, Handy horizontally swinging pilot couplers.
Jones Car Door Company, Chicago, Ill. Jones and Smith car doors.
Keystone Drop Forge Works, Philadelphia, Pa.
Kindl Car Truck Company, Chicago. Models of Kindl trucks, Cloud trucks, Woods pedestal roller swinging-motion truck.
Manning, Maxwell & Moore, New York. Inspirators, check valves, steam valves and strainers for locomotives.
McCord & Co., Chicago and New York. McCord journal box, McCord spring dampener, McKim gasket and Torrey anti-friction metal.
McConway & Torley Company, Pittsburg, Pa. Steel and malleable-iron couplers for freight and tenders of the Kelso and Janney patterns.
Merritt & Co., Philadelphia, Pa. Expanded metal lockers for shops, offices, roundhouses, etc.
Michigan Lubricator Company, Detroit, Mich. Lubricator and oil cups.
Nathan Manufacturing Company, New York. Injectors and lubricators.
National Car Coupler Company, Chicago, Ill. National steel platform and buffer for passenger cars, National freight car coupler, Hinson friction draft gear, and the Hinson drawbar attachment.
National Malleable Castings Company, Cleveland, O. Tower coupler.
Norton Grinding Company, Worcester, Mass.
Philadelphia Pneumatic Tool Company, Philadelphia, Pa.
Piper Friction Draft Gear Company, Cleveland, O. Draft gear.
John N. Poage Manufacturing Company, Cincinnati, O. Car showing the Williams grain door.
Railway Appliances Company, Chicago. Ajax canvas vestibuled diaphragms, auxiliary couplers and Gilman-Brown emergency knuckles.
The Railway Materials Company, Chicago, Ill. Flue-welding furnace in operation and the Ferguson portable heater.
Rand Drill Company, New York. Rand compressors—one style of Type 10 and three styles of Type 11. Plain belt-driven electric motor-driven and gasoline engine.
Republic Railway Appliance Company, St. Louis, Mo. Friction draft gear and dust guard.
Safety Car Heating & Lighting Company, New York, N. Y. A handsome exhibit of car lighting and heating apparatus, ornamental deck lamps, bracket lamps, gas ranges for private cars and buoy lantern.
Sellers, William & Co., Philadelphia, Pa.
Scullin-Gallagher Company, St. Louis, Mo. Miscellaneous steel castings.
Simplex Railway Appliance Company, Chicago. Simplex bolsters for 80,000-lb. capacity cars, also for 60,000-lb. cars. Susemihl frictionless roller side bearing.
Soule Raw Hide Lined Dust Guard, Boston, Mass.
Standard Car Truck Company, Chicago, Ill.
Standard Coupler Company, New York. Standard steel platforms, Sessions' standard friction draft gear, Standard couplers.
Sterlingworth Company, Easton, Pa.
St. Louis Car Company, St. Louis, Mo. Journal bearings.
Symington, T. H., & Co., Baltimore, Md. Journal boxes and dust guards.
J. S. Toppan Company, Chicago, Ill. The Kennicott water softening apparatus, Martin steam and air specialties and car-door seal and Miller grain door.
C. Vanderbilt, New York. One 12,000-gal. capacity all-steel tank car, built by the American Steel Foundry Company, St. Louis, and equipped with their trucks and truck bolsters; the Vanderbilt brake beam and a 100,000-lb. capacity steel hopper car equipped with the Vanderbilt cast-steel bolster, made by the Commonwealth Steel Company, St. Louis.
Western Railway Equipment Company, St. Louis.
The Westinghouse Air Brake Company, Pittsburgh, Pa. The American Brake Company, St. Louis, Mo.; Westinghouse Automatic Air & Steam Coupler Company, St. Louis, Mo. Triple valve-testing rack, two quarter-size four-wheel car models equipped with Westinghouse air brake, freight and passenger; Westinghouse friction draft gear, freight and passenger application; Westinghouse automatic air and steam coupler, freight and passenger; American automatic slack adjuster, freight and passenger; Westinghouse high-speed reducing valve.
G. S. Wood & Co., Chicago.